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AMERICAN MUSEUM NOVITATES

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A GIANT OXYAENID FROM THE UPPER EOCENE OF MONGOLIA

BY WALTER GRANGER

Mongolia has already produced gigantic members of two families of Tertiary mammals, *Baluchitherium* of the Rhinocerotidae and *Andrewsarchus* of the Mesonychidae. Now there appears a third relatively colossal form, a member of the Creodont family Oxyaenidae, briefly described below.

The type of this new form was discovered by Dr. A. Z. Garber, Surgeon of the Central Asiatic Expedition of 1930. Dr. Garber and the two surgeons on previous expeditions to the Gobi, having but little professional work to do, became ardent prospectors and many of the choicest palaeontological and archaeological finds are credited to them. The drawings are by John and Louise Germann.

SARKASTODON,[1] NEW GENUS

TYPE.—*Sarkastodon mongoliensis*, new species.

DIAGNOSIS.—Dentition; $\frac{2}{1}, \frac{1}{1}, \frac{3}{3}, \frac{1}{2}.$ Outer pair of upper incisors much enlarged and with the crowns meeting at the median line; inner pair vestigial and forced into a posterior position. Lower incisors very small and also forced into a posterior position by the massive and forward-placed canines. Upper and lower canines short but unusually robust. Upper premolars large, P^2 apparently two-rooted and crowded into a diagonal position in the tooth row. Lower premolars very robust and with small anterior basal cusps. M^1 developed into a great shearing tooth with a small protocone. Skull extremely short, broad, and massive. Jaw with heavy deep symphysis.

Sarkastodon mongoliensis, new species

TYPE.—Amer. Mus. No. 26641, front of skull with right ramus and anterior part of left ramus of lower jaws.

HORIZON AND LOCALITY.—Irdin Manha formation (Upper Eocene), about 25 miles southwest of Iren Dabasu, Inner Mongolia, collected by Central Asiatic Expedition, 1930.

PARATYPE.—Amer. Mus. 26302, right lower jaw with P_2–M_1, from the Ulan Shireh beds (= Irdin Manha) at Chimney Butte, Shara Murun region, Inner Mongolia. Collected by Central Asiatic Expedition, 1928.

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[1] σαρκάζω, to tear flesh, ὀδούς, tooth. A name suggested by Prof. W. B. Scott.

DIAGNOSIS.—The only known species of the genus. Measurements given below.

As is the case with many other Upper Eocene forms from Mongolia the closest comparisons of *Sarkastodon* are with North American rather than with European relatives. Here the nearest approach to this new form, both in size and structure, is found in the Middle Eocene genus *Patriofelis* which is exceeded in dimensions by at least 50 per cent. The generic distinctions from *Patriofelis* are found in the further reduction of the lower incisors, there being at least two in *Patriofelis* in the enlarged swollen lower premolars, especially P_2, and P_3, in the elongation of M_3, and in the extraordinary simple shearing development

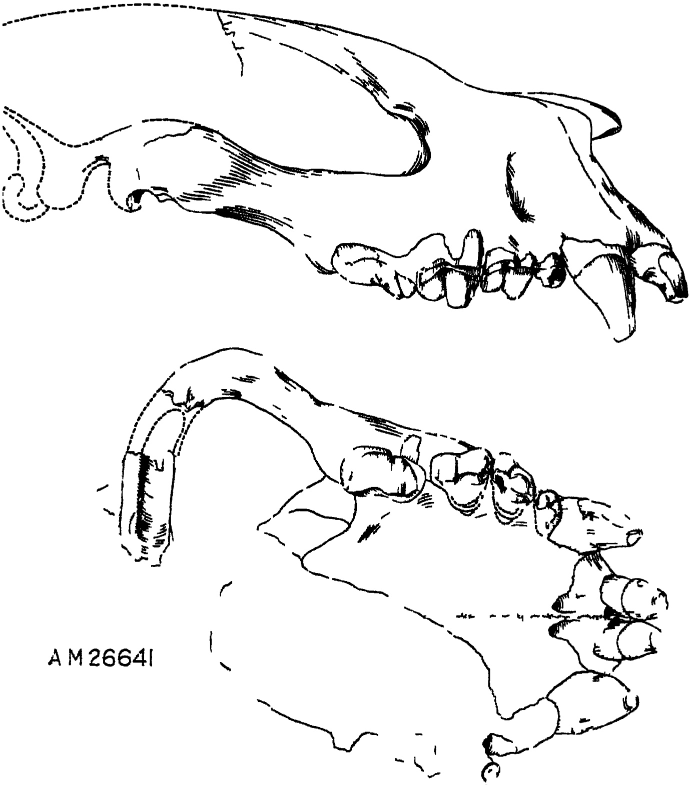

Fig. 1. *Sarkastodon mongoliensis.* Type, Amer. Mus. No. 26641. Right side and palatal views of the skull. × 1/5

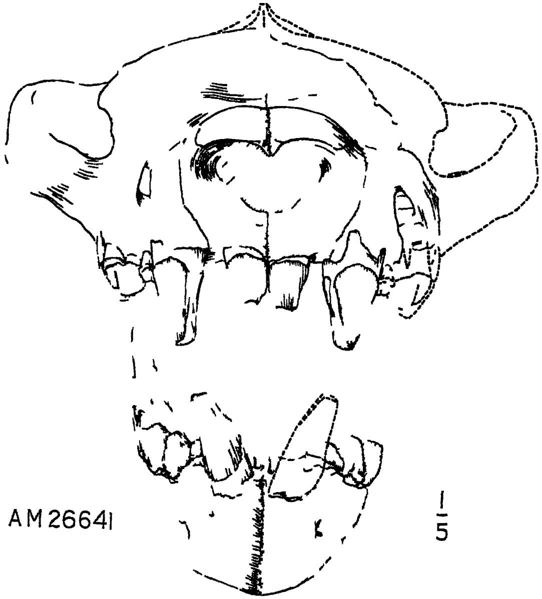

Fig. 2. *Sarkastodon mongoliensis.* Type, Amer. Mus. No. 26641. Front view of skull and lower jaws. × 1/5

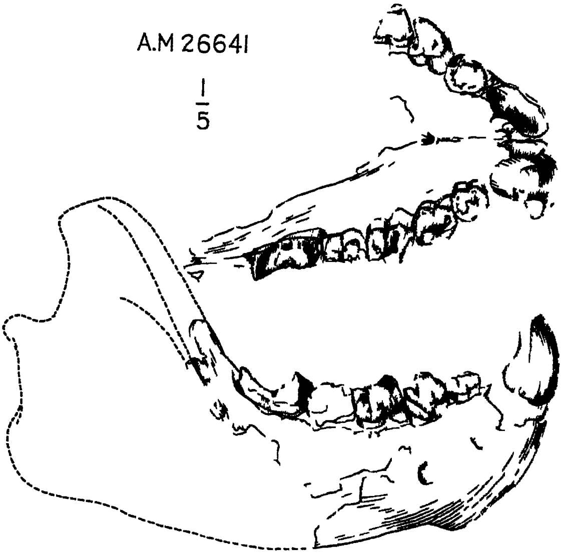

Fig. 3. *Sarkastodon mongoliensis.* Type, Amer. Mus. No. 26641. Right outer and superior views of lower jaws. × 1/5

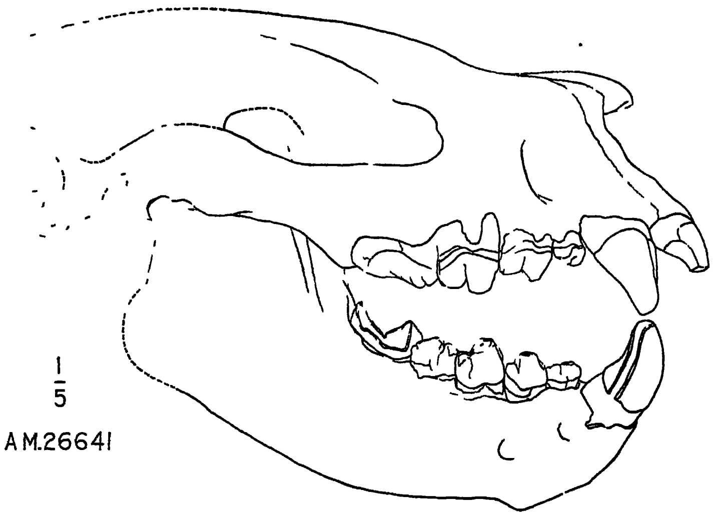

Fig. 4. *Sarkastodon mongoliensis.* Outline drawing of skull and jaws of type specimen supplemented by paratype lower jaw. Dotted lines indicate parts not known. × 1/5

of M^1. In *Sarkastodon* there is a short diastema in the lower tooth row between the canine and P$_2$; in the upper jaw there is a considerable gap between the enlarged incisor and the canine but none back of the canine. The skull-shortening process has resulted in the loss of P^1 and in the crowding of P^2 against the root of the canine and even forcing it into a position out of alignment with the posterior teeth. This extreme shortening and broadening of the skull together with the reduction of the lower incisors is foreshadowed in *Patriofelis.*

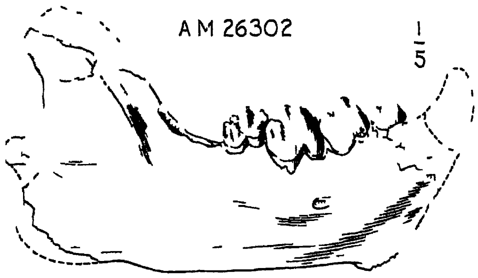

Fig. 5. *Sarkastodon mongoliensis.* Paratype, Amer. Mus. No. 23602. External view of right lower jaw. × 1/5

The paratype jaw, No. 26302, adds character in the back of the ramus and in the form of the M_1 which is seen to have a large anterior basal cusp and two smaller posterior ones. All four cusps are on a line and there is no tendency toward basining, this also being a distinctly shearing tooth. The paratype was found about 100 miles away from the type specimen in beds to which the local name of Ulan Shireh was given but which, since the fauna has been studied, are known to be the exact equivalent of the earlier-named Irdin Manha beds to the northward.

MEASUREMENTS OF TYPE SPECIMEN

Pmx. to posterior border glenoid cavity	350.0 mm.
Width across zygomatic arches	380.0 est.
Width across nasals at tip	100.0
C–M^1	205.0
P^2–M^1	157.0
P^2–P^4	100.0 approx.
I. tr. diameter at base	27.0
C. a-p., at base of enamel	39.0
M^1 a-p. diameter	64.0 approx.
M^1 tr. diameter	32.0 approx.
C.–M_2	215.0
Pm_2–M_2	161.0
C. at base of enamel, a-p.	36 5
P_2–P_4	89.0
P_2–tr. diameter	22.5
P_3–tr. diameter	26.3
P_4–tr. diameter	24.0
M_2–a-p. diameter	48.5
M_2–tr. diameter	19.5
Depth of ramus below P_4	82.0+
Depth of symphysis	111.0+

Further comparisons between *Sarkastodon* and *Patriofelis* as well as between other members of the Oxyaenidae will be found in a forthcoming review of the family by Mr. Robert Denison to whom I am indebted for several observations.

AMERICAN MUSEUM NOVITATES

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TWO INTERESTING MAYFLY NYMPHS WITH A DESCRIPTION OF A NEW SPECIES

By Herman T. Spieth[1]

An unique ephemerid nymph was collected by Stacey Denham in the White River at Decker, Indiana, July 27, 1932. From the structure of the specimen it was hypothesized that other individuals of the species would be found inhabiting sand bars. On June 20, 1936, twenty-five specimens were taken by the author on a sand bar a few miles down river from Decker. These all agree with the previous specimen in every detail except that they are not as mature. The original specimen was in the last instar and the wings were crumpled up inside the wing pads. One of the pads was cut from the specimen, the wing slipped out and uncrumpled as much as possible. It was apparent that the future adult wing was typically oligoneurid in construction and that the Rs would arise from about the middle of the radius. This plus the close similarity of the nymph to that of the European genus *Oligoneuriella* leads me to place this species tentatively in the American genus *Oligoneuria*. Although the adults of these two genera, as well as the nymph of *Oligoneuriella*, have been amply described, the nymph of *Oligoneuria* has never been identified. The description, which appeared in the Jour. N. Y. Ent. Soc., XLV, pp. 139–145, is as follows:

Oligoneuria ammophila, new species

Length, including tails, 12.5 mm.; exclusive of tails, 10 mm. Head roughly semi-globose with the mouth parts projecting postero-ventrally; compound eyes huge, occupying most of the area of the head, and contiguous along the mid-line, thus completely eliminating vertex except for a small area anteriorly. Nymphal eyes undivided; those of the adult as seen through the thin chitin show no indication of being divided. Lateral ocelli wedged between the antennae and compound eyes, being displaced so that they are anterior and ventral to the median ocellus which lies in an angle formed by anterior margins of eyes. Fronto-clypeal area greatly reduced; along edge of this area and the ventral edge of the parietal areas a fairly dense fringe of short setae. Antennae twelve-jointed, short and stubby; scape short and heavy; pedicel almost as heavy and much longer, comprising a third of the total length of the antennae; remaining segments subequal and gradually decreasing in diameter toward the tip.

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[1] College of The City of New York

Mouth parts typically oligoneurid; labrum (Fig. 10) uniformly pilose over the anterior surface; mandibles (Fig. 5) with a large, well-developed molar area, and reduced, smallish incisors, the outer one having three small teeth at tip and the inner one appearing like a huge, sharp-pointed seta; the lacina mobilis as long as outer incisor; maxillae (Fig. 1) with semi-lanceolate galea-lacinia; palps two-jointed; basal segment short and the distal one long, large, curved and finger-like; at the base of maxillae a large tuft of respiratory filaments as in *Oligoneuriella rhenana;* labium (Fig. 4) heavily pilose; glossae small and lying dorsal to the larger paraglossae; palps two-jointed, the second large and broadly expanded.

Thorax short and compact; the anterior and posterior margins of the pronotum straight and parallel. An extension of the postero-lateral area of the pronotum extending as a broad lobe-like projection posterior to the protheracic leg (Fig. 9). Wing pads large, thick and blackish as in all nymphs just before emergence; the metathoracic wings of the adult apparently large.

Legs (Figs. 7 and 8) peculiar in that the coxae and trochanters of the meso- and metathoracic legs are very long and robust. Coxa of fore-leg about three-fourths as long as femur; trochanter small; tibia forming a flat blade-like structure about one and one-half times the length of femur and ending in a blunt semi-hook, on the outer side of which is a small unsegmented papilla-like structure which represents the tarsus; inner side of basal half of femur and middle three-fourths of tibia bearing extremely long slender setae which are secondarily dissected as in *O. rhenana;* a patch of long slender setae on inner surface of coxa; outer surface of coxa, trochanter and femur sparsely setose. Coxa of second leg subequal to femur, longer than any other part and covered with setae on outer surface; trochanter robust and longer than tibia or tarsus, and expanded and rounded on medio-ventral surface, this surface being covered with long robust setae; femur covered with robust setae; tarsus subequal to tibia and both sparsely covered with short setae; tarsus ending in a single slender claw. Coxa of hind leg heavy and long, representing one-third of entire length of leg, and fairly densely covered by long slender setae; short, semi-globose trochanter covered with long slender setae on ventral surface; femur, tibia and tarsus, which decrease in length and robustness in order named, clothed with long, heavy setae: tarsus tipped by long slender claw. Adult legs as seen through the nymphal chitin appearing very slender and weak.

Abdomen long, slender and cylindrical; segments gradually increasing in length and decreasing in diameter from first to ninth inclusive; tenth segment considerably smaller than any other; tergites uniformly covered with short, stubby setae; on anterior sternites setae much denser, longer and finer than on corresponding tergites, with a gradual reduction in density and length of setae on more posterior sternites until ninth sternite matches ninth tergite; in addition a distinct fringe on posterior edge of all sternites due to increased density and length of setae. Through the thin nymphal chitin, it can be seen that the adult would have a broad dark, irregular band on its posterior edge of each abdominal tergite increasing in width posteriorly until that of the ninth segment would occupy almost half of the tergite; no indications of postero-lateral spines on segments 1 to 7 inclusive; lateral spines on segments 8 and 9 short, not extending beyond posterior margin of their respective segments.

Gills present on abdominal segments 1 to 7 inclusive; last six (Figs. 2 and 3) consist of single, slender, flat, plate-like structures which extend postero-laterally from posterior angle of each segment, apparently none having any tracheae; first gill

(Fig. 11) a huge, highly dissected plate-like structure that has migrated and rotated so that it extends ventrally and parallel to the longitudinal axis of the body and lies between the posterior pair of legs. It is completely invisible from a dorsal view and when first seen seems to arise from the thorax; also there is a median, finger-like, posteriorly directed process from posterior edge of first sternite.

Nymphal genital apparatus appearing as a truncate cone with a concave top surface. It is impossible to determine what the adult genitalia would be like. Three subequal caudal tails; lateral ones having a dense fringe of long, slender setae on inner side and a similar fringe on both sides of middle tail; laterals with 25 segments, the middle tail 22.

HOLOTYPE.—Decker, Ind. (White Riv.), July 27, 1932 (Stacey Denham); in collection of the Amer. Mus. Nat. Hist.

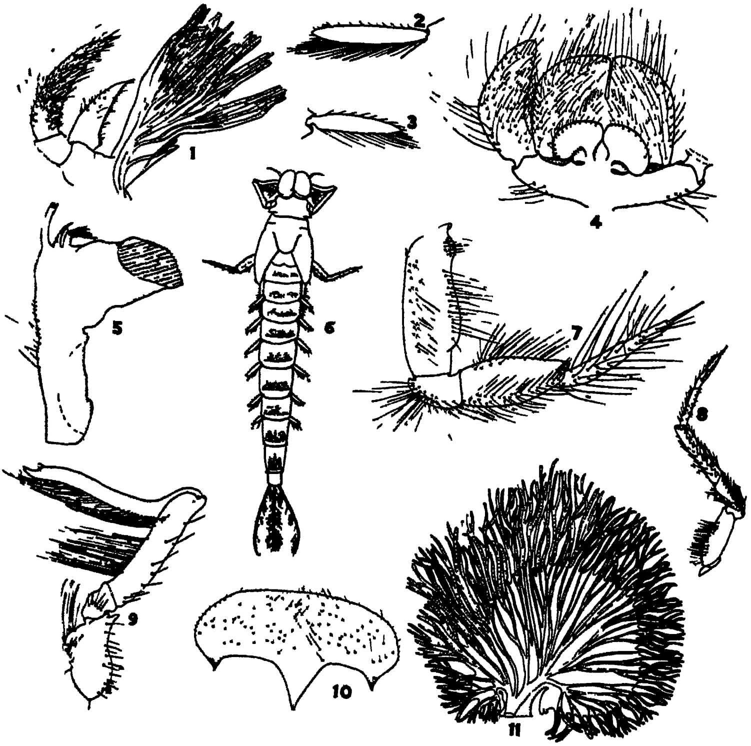
PARATYPES.—Hazelton, Ind. (White Riv.), June 20, 1936 (H. Spieth); 17 in collection of the Amer. Mus. Nat. Hist.; 2 in collection of Cornell Univ.; 2 in Canadian Nat. Coll.; 2 in collection of Univ. of Mich.; 2 in author's collection.

This species is somewhat closely related to *O. rhenana* as shown by (1) the general appearance of the nymph; (2) the head and especially the mouth parts; (3) the position and shape of the fore-leg as well as the disposition and secondary dissection of the setae on the fore-femur and tibia; (4) the location of the first gill on the ventral surface of the abdomen. It differs from *O. rhenana* in that (1) the fore-leg has a rudimentary tarsus; (2) the first gill has completely lost the lamellae and (3) the last six gills lack the fibrillar portion.

The paratypes were all found on the clean sand of a bar in about one foot of water. The current was moderately swift. In addition to *O. ammophila* a species of *Brachycerus* was found in abundance on the same bar. Both species occupied distinct areas and the ranges barely overlapped. *O. ammophila* was found in the swifter current and the bottom was not smooth but rather filled with a great many small depressions. The sand was clean and lacked any trace of silt. *Brachycerus* selected calmer, smoother areas where a small amount of silt was mixed with the sand.

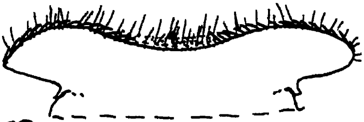
While collecting *O. ammophila*, a single specimen of an unknown genus was taken. Despite intensive attempts, no more individuals of this species were found. It is so extraordinary, however, that it deserves description, which is as follows:

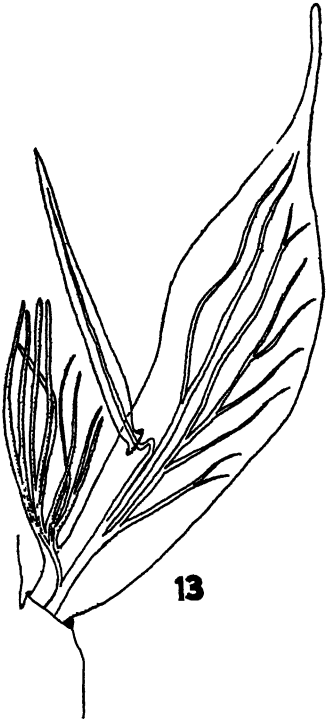
The specimen, a female, is apparently in early phase of last instar. The future venation of adult is clearly discernible in nymphal wing pad. Length, exclusive of tails, 13 mm. Head depressed, heptagenid in construction except that (1) the fronto-clypeal area, especially between antennae, is elevated; (2) the compound eyes are more anterior from the posterior margin than usual. From dorsal view head is

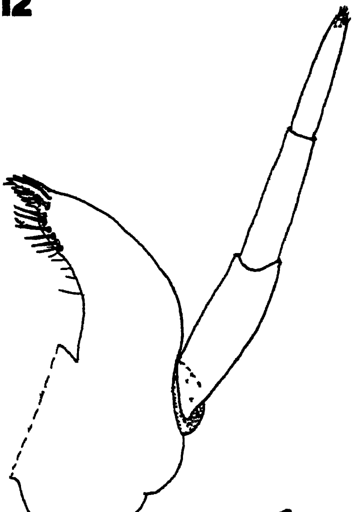


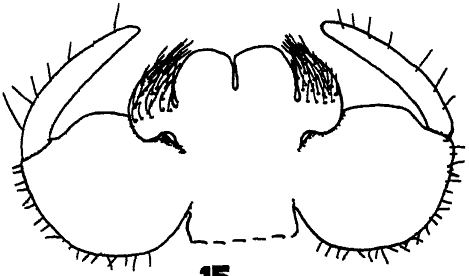
Oligoneuria ammophila, new species.

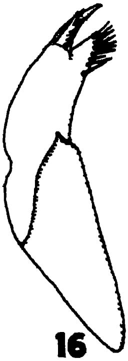
Fig. 1. Right maxilla.
Fig. 2. Second gill.
Fig. 3. Seventh gill.
Fig. 4. Labium.
Fig. 5. Right mandible.
Fig. 6. Dorsal view of nymph
Fig. 7. Metathoracic leg.
Fig. 8. Mesothoracic leg.
Fig. 9. Prothoracic leg.
Fig. 10. Labrum.











New carnivorous heptagenid.

Fig. 11. First gill.

Fig. 12. Labrum.

Fig. 13. Sixth gill—ventral view.

Fig. 14. Left maxilla.

Fig. 15. Labium.

Fig. 16. Right mandible.

bowl-shaped in outline and widest near posterior border. Antennae arise from side of elevated area; scape and pedicel subequal in size; both flagella broken and lost.

Labrum (Fig. 12) broadly expanded laterally, slightly concave on anterior margin, outer surface sparsely setose and a row of setae on anterior margin. Mandibles (Fig. 16) slender, lacking molar area, while robust incisors consist of single huge fang with secondary tooth arising laterally; the lacina a huge seta, serrate along one side. Median to the lacinia mobilis is a cone-shaped projection bearing 11–13 robust setae. Maxillae (Fig. 14) slender, with distal end of galea-lacinia bearing three slender fangs, medial one of which is a large body representing a seta that is flattened, broadened and laterally serrate. Still more median to this are a number of robust setae. Palps three-jointed. All mouth parts and especially the mandibles and maxillae conspicuous for their lack of pilosity. Labium (Fig. 15) with short rounded naked glossae; paraglossae lateral, arising postero-laterally from glossae and having a slight posterior lobe reminiscent of the heptagenids; palps two-jointed, basal segment broad, flattened and sparsely pilose on posterior margin; second joint is slender and cylindrical.

Prothorax broad, flaring laterally with postero-lateral extensions extending alongside of wing base. Median to this extension on posterior margin is a large, deep, somewhat rectangular incision. Meso- and metathorax short and broad. Mesothoracic wing pads extending to middle of fourth abdominal segment; venation clearly heptagenid. All legs similar; femur slender, much flattened, naked except for anterior edge which is densely covered with long slender setae; femur slightly longer than tibia and tarsus combined; latter two slender, and naked except for few setae at distal tip of tarsus; tarsus subequal to tibia; single long, slender, smooth tarsal claw which is subequal to tarsus in length.

Abdomen slender, moderately flattened; gills on segments 1–7 inclusive; no postero-lateral spines except extremely small ones on segments 8 and 9; general ground color cream, with tergite 8 completely light chocolate and dark median marks at anterior edge of second, third, sixth and seventh tergites. In addition a slight infuscation at antero-lateral areas of tergites 3, 4, 5, 6 and 7; ninth sternite deeply incised on posterior margin. Gills (Fig. 13) except for first one, compound, consisting of a lanceolate lamella and a fibrillar portion; first gill of fibrillar portion only lacking lamella. Each lamella has, in addition to fibrillar portion, a narrow, slender, flattened projection arising from ventral surface at about one-third of the distance from the base of the lamella. A branch of the lamellar trachea supplies this projection.

Tails three; unfortunately tips of all are broken; lateral ones with dense band of slender setae on inner side; middle tail with setae on both sides; middle one under normal conditions obviously much shorter than laterals.

Collected at Hazelton, Ind. (White Riv.), June 20, 1936 (H. Spieth). Specimen in the collection of the Amer. Mus. Nat. Hist.

The complete lack of the molar area of the mandibles, the fang-like condition of the incisors plus the fang on the galea-lacinia of the maxilla indicate that this species must be a carnivore. This is further confirmed by the slender build and immaculate condition of the specimen which indicate it is an active, agile creature. In addition, although it was taken from a swift current it possesses no structures such as *Isonychia* or *Oligoneuria* have for filtering micro-organisms from the water.

The construction of the head and gills alone would be sufficient to identify this species as a heptagenid. The fact that the future adult venation can be determined serves as positive confirmation. There is no doubt that the species is a member of a genus of which the nymph is unknown. Whether it is a member of a completely new genus or of a genus whose adult is known but whose nymph has not yet been identified is the next question. Since the genera of the family Heptageniidae are as a group fairly well known, it appears unlikely that this nymph represents a new genus. In the Mississippi Valley exists the genus *Pseudiron* known from two species represented as yet only by imagoes. and it is possible that the present specimen is a nymph of *Pseudiron.* The facts that the ninth abdominal sternite of the nymph has a deep V-shaped incision on the posterior margin and that a similar condition exists in the imagoes of *Pseudiron* seem to be evidence pointing to such a conclusion.

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A NEW *EUREMA* FROM PUERTO RICO (LEPIDOPTERA: RHOPALOCERA)

BY FRANK E. WATSON

Eurema sanjuanensis, new species

MALE.—Upper side of all wings clear pale lemon-yellow except as noted. Primary with a thin black marginal border from costa beyond apex to a point between Cu_2 and Cu_1. This band is slightly waved on its inner edge and but slightly thickened at apex, where it becomes attenuate along costa at about 1/3 from the apex. The black scaling is continued thinly along costa to the base. Outer margin nearly straight, but slightly waved, and nearly at a right angle with inner margin. Fringes blackish at the marginal border and concolorous beyond to inner margin. Secondary entirely immaculate; costal area paler; area between A_2 and abdominal margin whitish. Outer margin well rounded. Fringes concolorous. Under side of all wings paler, immaculate, except as noted. Primary, without any discal dots, with inner marginal area paler, tending to whitish. Secondary with two slight, brown discal dots. Palpi yellowish white, joints 2 and 3 brownish. Thorax above, mostly denuded, but still retaining some pale yellow hairs. Below, yellowish white. Abdomen pale yellow above and below. Legs yellowish white. Antennae, brown, narrowly ringed with yellowish; club, dark brown.

Expanse, 34 mm. Length of primary, 17 mm.

HOLOTYPE.—Male, San Juan, Puerto Rico, July 1–5, 1915 (Lutz and Mutchler), in the collection of The American Museum of Natural History.

REMARKS.—It seems best, at least for the present, to consider *E. sanjuanensis* as a distinct species, although it may later prove to be a subspecies of *E. dina dina* (Poey)[1] from Cuba. It differs, among other things, from the West Indian subspecies of *dina*, before me, in its pale lemon-yellow ground color, the abdomen above is pale yellow, black in the *dina* subspecies, and it lacks the discal dot on primaries beneath.

It is closest to *E. dina parvumbra* (Kaye)[2] from Jamaica, which has deep yellow to orange-yellow wings above and secondaries with a little orange along outer margin. Below, the Jamaican subspecies has the secondaries dull orange-yellow with some scattered small dark diffused spots.

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[1] 1832. *Terias dina* Poey, Cent. Lep.

[2] 1926. *Terias dina parvumbra* Kaye, Trans. Ent. Soc. Lond., 1925, p. 481.

The subspecies from Hispaniola is *E. dina memulus* (Butler).[1]

The above three West Indian subspecies, as well as two from the mainland, will be found discussed and figured in 'A Revision of The Genus Eurema Hübner' by A. B. Klots, 1929, Ent. Amer., (N.S.) IX, p. 139, pp. 161–162, Pl. III, figs. 79–80, Pl. IV, figs. 81–88.

This species, *E. sanjuanensis*, need not be confused with *E. portoricensis* (Dewitz),[2] also from Puerto Rica, which has the outer margin of the primary rounded, and both primary and secondary with a narrow black border.

E. dina helios M. Bates,[3] from the Bahama Islands, is an orange subspecies. The Museum collection contains three paratypes.

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[1] 1871. *Terias memulus* Butler, Proc. Zool. Soc. Lond., p. 251, Pl. XIX, fig. 6.

[2] 1877. *Terias citrina* var. *portoricensis* Dewitz, Ent. Zeit., p. 237.

[3] 1934. *Eurema dina helios* M. Bates, Occ. Pap. Bost. Soc. Nat. Hist., VIII, p. 133

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A NEW SPECIES OF GASTROTRICHAN—*CHAETONOTUS ROBUSTUS*, NEW SPECIES

BY DONALD B. DAVISON

In the summer of 1926, the writer found a worm, apparently undescribed, but obviously referable to the genus *Chaetonotus* among the Gastrotricha, in material collected in a woodland swamp near Bedford, Westchester County, New York. In July of the year 1937, a similar individual was discovered in material gathered from a small woodland pool in the Great Swamp near Chatham, Morris County, New Jersey; and the latter specimen has been taken as the type of a new species, for which the name *Chaetonotus robustus* is proposed.

Subsequent investigation at the last-mentioned locality soon brought to light four additional living specimens, along with a dead, but well-preserved individual and fragmental remains of another. All the foregoing material, including the type specimen, has been turned over to The American Museum of Natural History.

One striking feature of *Chaetonotus robustus* is its size. Extended individuals attain a length (exclusive of the anterior sensory tufts) of 585–615 microns (type specimen 601 microns); even contracted and enrolled individuals measure 389–435 microns, their bulkiness rendering them objects just visible to the naked eye. The largest species of *Chaetonotus*, as the genus is now defined (Remane 1935), is *Chaetonotus simrothi* Voigt (427 microns).

Figure 1 represents the general appearance of the new species in a moderately extended condition. When fully extended, its shape becomes even more strap-like, presenting only slight variations in width (maximum width of type specimen 110 microns, at a point two-thirds distant from the anterior end).

The width of the head is approximately 95 microns; its anterior margin rounded, five-lobed by virtue of low-arched, closely applied plates—the posterior lobes in a greatly reduced condition, however. Anterior and lateral sensory tufts both present, composed of short, fine hairs.

In fully extended individuals a slightly constricted neck region is sometimes evident.

The posterior third of the body narrows to a width equal to about two-thirds that of the head and terminates in a pair of rather widely separated, backwardly directed caudal processes, comprising short conical bases and slender extensions that curve ventrally and slightly toward each other and end in minute, abruptly-pointed tips. The length of the caudal processes, exclusive of their bases, is 47 microns Slight swellings project from the undersides of the extensions just behind their junctures with the conical bases (Fig. 4), but annulated features of any sort are lacking. The bases—or at least the greater parts of them—are smooth surfaced, without scales or bristles. Several of the latter, however, appear on adjacent parts of the body proper, rather long ones arising from the region lying between the caudal processes.

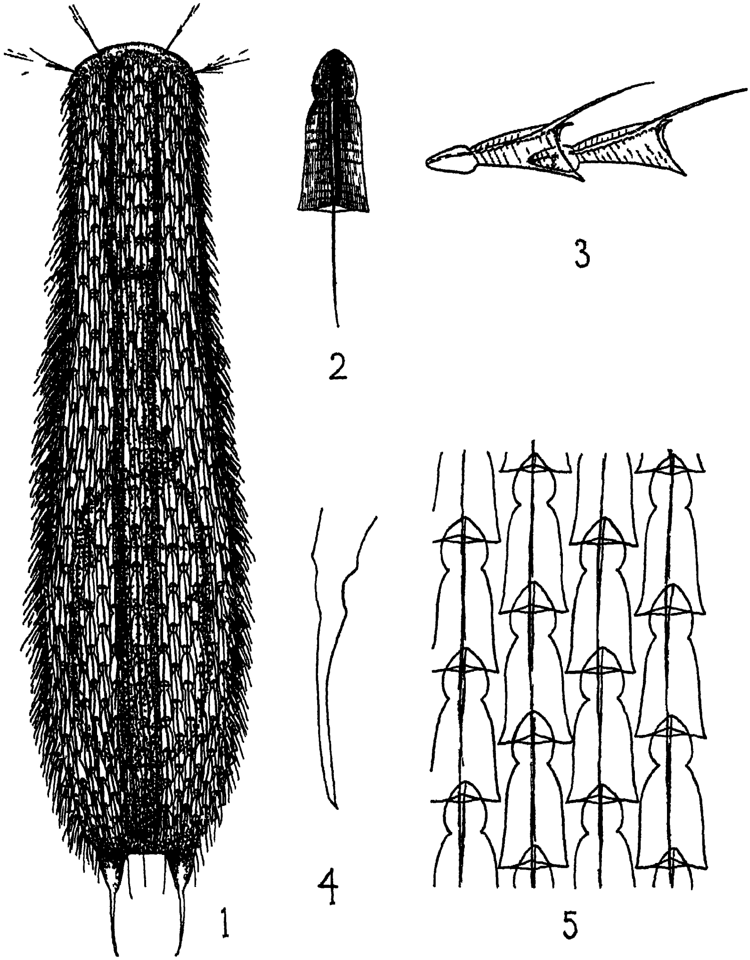
The entire dorsal surface of the body, together with its sides and apparently a considerable portion of its ventral surface, is thickly covered with scales, bearing simple, backwardly directed spines.

The scales conform to the general type of dermal appendage found in the genus *Chaetonotus* (bearing perhaps the closest resemblance to certain body scales of *Chaetonotus elegans* Konsuloff), but seem to be larger and more elaborate than any heretofore described for members of that group (Fig. 2).

They consist essentially of flat, rounded bases closely applied to the cuticle, with long, pouch-like extensions (each composed of two divergent laminae), freely projecting from their posterior edges. The spines are recumbent for considerable distances, forming conspicuous median ridges on the dorsal surfaces of the scales. The freely extending portions of the spines are slightly arched and taper to fine points.

Scales occurring on different parts of the body appear to differ in little other than size and relative proportions. Those of the type specimen furnished the following measurements. Scales from the head region: total length (exclusive of spines) 20 microns; maximum width 6 microns; length of free portion of spine $16^1/_2$ microns. Scales from the posterior region of the body: length $32^1/_2$ microns; width 16 microns; spine 29 microns. These figures are fairly representative of the dimensions of the scales in other specimens (smallest head scale $14^1/_2$ microns long with a spine extending 13 microns further; largest body scale 36 microns with a spine 25 microns). The length of the base (included in the total length measurements given above) in all cases was about 11 microns; its width was practically the same (10–$12^1/_2$ microns).

The largeness of these scales brings to light structural features that



Chaetonotus robustus, new species.

Fig. 1. General appearance, dorsal view, × 211. Fig. 2. Body scale, dorsal view, × 692. Fig. 3. Body scales in situ, lateral view, × 692. Fig. 4. Left caudal process, lateral view, × 718. Fig. 5. Diagrammatic representation of arrangement of scales, dorsal view, × 692.

do not seem to be recorded for the scales of related species, namely, 10–12 evenly spaced transverse ridges on the dorsal laminae (which probably denote lines of growth), and 30 or more exceedingly fine, longitudinal striae running down the entire dorsal surface of the scale. The latter features were also observed on the ventral laminae. In the writer's opinion, they are to be interpreted as the lines of demarcation of agglutinated cilia. If this is correct, they determine the phylogenetic derivation of the dermal appendages of the group.

The scales are arranged in compact, longitudinal rows, with the scales in alternate rows lying at corresponding levels (Fig. 5). At least 20 such rows are visible simultaneously at the widest part of the body of a moderately contracted individual.

As already noted, only the rounded bases of the scales are attached to the cuticle; and, as the juncture of the base with the rest of the scale is flexible, the posterior portion, with its spine, may be, and frequently is, bent almost perpendicularly to it and to the surface of the body. This is seen on an extensive scale when the animal rolls up, the tautness of the cuticle evidently contributing to that effect.

Usually, however, the scales, when viewed from the side, present the appearance shown in Fig. 3. They overlap to a slight extent, but the ends of the spines extend so far as to overlie the recumbent portions of succeeding spines, making them appear confluent in the dorsal aspect (Fig. 5). The number of scales in any one row is from 20 to 26. The rows apparently end just short of the caudal processes.

On anaesthetization and at death, the animal invariably rolls up, a circumstance that prevented detailed observation of the heavily ciliated tracts on the ventral surface of the body.

Under ordinary magnification, the mouth appears to be provided with a circlet of stout setae; but that of one of the preserved specimens, under high magnification, is seen to be surrounded by 15 or more soft linguiform processes, with the same type of finely striated surface, as are to be found on the scales. These are features that call for further investigation.

When the body is fully extended, the pharynx is about 125 microns in length and the intestine around 400 microns. The former is of fairly uniform width, although sometimes displaying transverse folds. In the type specimen, the ovary, overlying the intestine, contained several immature eggs. The heavy dermal covering of the animal makes study of its internal organs difficult.

Algae are at least one of its dietary constituents; for the intestine of the dead specimen contained a stout *Closterium* 220 microns in length and another attenuate *Closterium*, that was 474 microns long. The latter extended through the intestine into the pharynx and served to keep the animal in an extended condition (585 microns). Unfortunately the algae were expelled by the increased pressure occasioned by the lowering of the cover-glass; whereupon the body at once contracted and rolled up.

A word as to the ecological conditions of the two stations in which *Chaetonotus robustus* was found.

Both were undrained, shady bogs, filled with decaying leaves and fringed with Sphagnum, with a floating mat of Lemna and other aquatic vegetation in the deeper parts. *Ricciella fluitans* was also present in abundance at the New York locality. The fauna in each instance included such Protozoa as *Pelomyxa villosa*, *Difflugia pyriformis* and *Difflugia acuminata*, *Lecquereusia modesta*, *Metopus sigmoides*, *Spirostomum ambiguum* and *Spirostomum teres*, *Caenomorpha medusula*, *Stentor polymorphus*, *Menoidium pellucidum* and *Distigma proteus*. Nematodes and oligochaetes (*Stylaria* and *Dero*) were also present. Among the Gastrotricha found at the New Jersey station may be mentioned *Polymerurus rhomboides* Stokes, *Dasydytes saltitans* Stokes, *Dasydytes bisetosus* Thompson, *Aspidiophorus paradoxus* Voigt, *Polymerurus nodicaudus* Voigt and *Stylochaeta fusiformis* Spencer, the four last species not having heretofore been reported from North America.

Two of the specimens of the new worm were taken from tangled vegetation at the top of the collecting bottle, but all others came from the bottom detritus, where the above-mentioned elements of the fauna were especially prevalent. Probably most of the progress of *Chaetonotus robustus* is accomplished by creeping, for no swimming individuals were observed.

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A NEW SPECIES OF FROG OF THE GENUS *TELMATOBIUS* FROM CHILE

By G. K. Noble

Since Barbour and Noble (1920) revised the South American bufonids of the genus *Telmatobius* our knowledge of the southern representatives of this group has been greatly improved by a taxonomic study by Schmidt (1928) and a life-history study by Fernandez (1926). *Telmatobius* is a bufonid of especial phylogenetic interest because it merges by small intergradations into *Batrachophrynus*, a genus which in older classifications was placed in a different family. *Batrachophrynus* differs from *Telmatobius* chiefly in the loss of maxillary teeth. It is however a lake frog while *Telmatobius* abounds along small streams and ponds. The loss of maxillary teeth in this natural group of bufonids is correlated with a life in the deep, cold waters of Andean lakes.

It is therefore a matter of phylogenetic interest that the International High Altitude Expedition to Chile collected a series of *Telmatobius* from a warm spring near Ollague, Chile, which although resembling *T. peruvianus* Wiegmann closely, differs remarkably in the great reduction of the maxillary teeth. Only a few small tooth rudiments are visible on the upper jaw of these specimens. The reduction in size and number of the maxillary teeth in the *Telmatobius-Batrachophrynus* group of bufonids is not therefore always dependent on cold, deep water for its realization.

The series of *Telmatobius* collected at Ollague differs not only in dentition but in several other features from typical *T. peruvianus*. They have longer, flatter snouts, smoother dorsal skin and shorter hind legs. They represent in fact a new species which I take pleasure in naming after Dr. F. G. Hall, zoologist of the expedition and collector of the series of both adults and larvae which forms the basis of the following description.

Telmatobius halli, new species

Type Locality.—Warm spring near Ollague, Chile, 10,000 ft. altitude, June, 25, 1935, Dr. F. G. Hall, collector.

Material.—Five adult females, one sexually immature female and six tadpoles, all collected from the same spring as the type.

DESCRIPTION OF TYPE SPECIMEN. A.M.N.H. No. 44753, adult female. Tongue oval, entire, two-thirds the width of mouth at its greatest transverse diameter; vomerine teeth absent; snout flat, without canthus rostralis; distance between nostril and anterior corner of the eye equal to greatest diameter of the eye; nostril slightly nearer the tip of snout than the eye; interorbital width approximately equal to upper eyelid; eyes set at angle of 45 degrees with the midline, no tympanum; first finger a little longer than the second; toes webbed to the tips but so emarginate that they appear only half webbed; subarticular tubercles prominent, continued as rows of small tubercles on the sole of foot and tarsus; inner metatarsal tubercle about twice as long as the outer; inner margin of the first toe continued as a fold along the inner margin of the tarsus; tibio-tarsal joint carried forward extends to the posterior margin of the eye. Dorsum practically smooth, only a few feeble tubercles being present; a few tubercles on the posterior surfaces of the thigh, these becoming prominent around and below the vent; skin on the remainder of legs, and upper surfaces of arms smooth; on lower surfaces of arms skin slightly tubercular.

Very dark brown above, finely spotted with white on the sides of body, upper jaw olive spotted with dark brown.

MEASUREMENTS

Length of head and body	57 mm.
Arm from axilla	32 mm.
Leg from groin	89 mm.
Tibia	25 mm.
Greatest width of head	19 mm.

VARIATION.—The series of five paratypes (A.M.N.H. No. 44754–8) differs consistently from *T. peruvianus* in being spotted above. In the type the spotting was restricted to the sides of the body. In two of the paratypes the pale body color is dominant and both head and body are predominantly pale brown finely marbled or spotted with a darker tone.

It is remarkable that four of the five paratypes—like the type—are sexually mature females and yet they vary considerably in size. The smallest of these ripe females is 42 mm. in head and body length while the largest, the type, is 57 mm.

In *T. peruvianus* the maxillary teeth average about 0.6 mm. in height. In the present species the maxillary teeth are mere rudiments a half or a third this size. In all of the paratypes the teeth do not penetrate the mucosa of the jaws but may be found with the help of a needle on the more anterior sections of the maxillae.

The six tadpoles (A.M.N.H. No. 44759) in the series are large, ranging in total length from 70 to 83 mm. The smallest have the limb rudiments barely visible, while the largest have the hind legs 15 mm. long. The tadpoles differ consistently from the tadpole of *T. aemaricus* described and figured by Fernandez (1926) in having long pointed tails.

These are a third longer than the head and body instead of being only a little longer as in *T. aemaricus*. The dorsal fin is, however, narrow as in *T. aemaricus* and the distal third or two-fifths is thickly spotted with dark brown as in that form. The color of the head and body is uniform brown irregularly spotted with a lighter brown. Apparently the body is more spotted than that of *T. aemaricus* to judge from Fernandez' figure.

It is remarkable, however, that the mouth parts of the tadpoles in the present series should be apparently identical to those of *T. aemaricus*. Further, the tooth-rows of *T. peruvianus*, as stated by Schmidt (1928), have the same number and form. The sinistral spiracle and dextral vent are the same as in *T. aemaricus*. In brief, the tadpole of *T. halli* agrees closely with that of *T. aemaricus* as described by Fernandez (1926), but differs in its longer and more pointed tail. Further, while the tail is spotted much as in that species, the head and body appear to be more spotted.

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AFRICAN MUSCIDAE.—V

BY C. H. CURRAN

The present paper contains descriptions of a number of undescribed forms, and keys to the known species belonging to several genera. The preceding papers in this series are contained in American Museum Novitates Nos. 738, 776, 788 and 931.

Neodexiopsis colorata, new species

Reddish yellow, brown and cinereous; abdomen brown and yellow fasciate; legs almost all yellowish. Length, 5 to 5.5 mm.

MALE.—Head black in ground color, only the facial ridges yellowish. Front brown pollinose, in some lights appearing opaque black, the short ocellar triangle paler brown; parafrontals cinereous, somewhat brownish opposite the ocelli. Three pairs of strong frontals and one or two weak pairs; ocellars moderately long; verticals long, the outer verticals moderately long and divergent. Occiput cinereous. Face and cheeks cinereous white pollinose, the cheeks and parafacials narrow. Vibrissae long and strong. Palpi reddish yellow with brownish apices. Basal antennal segments brownish yellow, the third black. Arista brown, very short plumose.

Thorax yellowish, the pleura with some brown stains, the mesonotum and scutellum brown or black in ground color and thickly pollinose. Sides of the mesonotum yellowish, the disc with grayish-brown pollen and five blackish vittae, the outer vittae short and not conspicuous. Scutellum brownish gray, with four bristles and a few scattered setulae. Metanotum black, grayish pollinose except posteriorly.

Legs reddish yellow, the tarsi somewhat darkened apically; posterior four femora usually with pale brown preapical band. Bristles long and rather fine.

Wings cinereous hyaline, sometimes with brown tinge. Costal spine absent. Squamae whitish. Halteres yellow.

Abdomen reddish yellow, with brown fasciae dorsally. Basal half of the first segment with the depression and a medium vitta brown, the brown vitta connected with a broad brown fascia lying mostly behind the middle of the segment, its sides narrowed and separated from the posterior margin of the segment by a broad, interrupted posterior fascia. Second to fourth segments each with a broadly interrupted basal and apical yellow fascia, the black on the fourth segment sometimes greatly reduced. The small fifth segment and genitalia are yellowish or yellowish red. Bristles on the sides of the abdomen long; third and fourth segments each with a row of discals on the posterior half. Pale parts of the tergites very thinly whitish pollinose.

FEMALE.—Agrees with the male but the abdomen is not so slender and tapers apically.

TYPES.—Holotype, male, and allotype, female, Vumba Mountains, Southern

Rhodesia, March, 1935. Paratypes, two males taken with the holotype; male, and two females, Chirinda Forest, Southern Rhodesia, November, 1930, all collected by Alexander Cuthbertson.

This species is readily distinguished from the others in the genus by its coloration.

Hydrotaea Desvoidy

Desvoidy, 1830, Mem. Acad. Roy. Sci. Inst. France, II, p. 509.

Seven species are known from Africa while an eighth is doubtfully placed in the genus.

Table of Species

1.—Eyes densely long haired .... 2.
Eyes sparsely short haired or bare .... 3.
2.—Mesonotum blackish, unicolorous .... *fumifera* Walker.
Mesonotum cinereous with a broad postsutural black band and three anteriorly united black spots in front of the suture, the median spot extending to the suture .... 8.
3.—Mesonotum strongly bicolored, from posterior view, cinereous in front of the suture and before the scutellum .... 4.
Mesonotum unicolorous or nearly so .... 5.
4.—Abdomen broadly yellowish basally; parafacials and parafrontals polished black .... *melliventris* Malloch.
Abdomen black in ground color; parafacials pollinose..... *maculithorax* Stein.
5.—Abdomen and legs rusty reddish yellow .... *tersa* Wiedemann.
Abdomen and legs black .... 6.
6.—Posterior femora curved, swollen on the under side apically .... 7.
Posterior femora straight and not swollen ventrally .... *nigribasis* Stein.
7.—Squamae whitish; middle femora without blunt-tipped bristles on the posteroventral surface .... *longipila* Stein.
Squamae brownish; middle femora with about six blunt-tipped bristles near the middle on the posteroventral surface .... *femorata* Stein.
8.—Abdomen with the broad black segmental fasciae basal .... *fasciata* Stein.
Abdomen with the broad black segmental fasciae apical..... *maculithorax* Stein.

Hydrotaea fumifera Walker

Anthomyia fumifera Walker, 1856, 'Dipt. Saunders.,' p. 358.
Anthomyia maura Walker, 1856, 'Dipt. Saunders.,' p. 364.
Stein, 1918, Ann. Mus. Nat. Hung., XVI, p. 193.

Male, East London, S. Africa, August 9, 1922 (H. K. Munro).

Hydrotaea nigribasis Stein

Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 507.
Malloch, 1924, Ann. Mag. Nat. History, XIV, p. 259.

Known only from Natal.

Hydrotaea longipila Stein

STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 194.

Described from Natal.

Hydrotaea femorata Stein

STEIN, 1914, 'Voy. Allauad and Jeann.,' Dipt., p. 117.
MALLOCH, 1924, Ann. Mag. Nat. Hist., XIV, p. 259.

Described from British East Africa and recorded by Malloch from Natal.

Hydrotaea fasciata Stein

STEIN, 1913, Ann. Mus. Nat. Hung, XI, p. 505.

Male, Addis Ababa, Abyssinia, August 8, 1920; female, Addis Ababa, August 18, 1920 (B. Brown); male, New Hanover, Natal, December 1, 1914 (C. B. Hardenberg). Previously recorded from Abyssinia, East Africa and Transvaal.

The female may belong with the following species. The abdomen is stained and I am unable to place it definitely.

Hydrotaea maculithorax Stein

STEIN, 1913, Ann. Mus. Nat Hung., XI, p. 506.

Four males from Addis Ababa, Abyssinia, July 5, and August 8, 12, 1920 (B. Brown).

Stein described only the female from Southern Rhodesia, stating that the eyes were sparsely, long haired. The males, which probably belong here, have the eyes thickly haired, the median black vittae on the mesonotum fused as in *fasciata*, the postsutural black fascia divided, when seen from behind, by two narrow cinereous vittae; median and apical segmental markings on the abdomen black.

Hydrotaea melliventris Malloch

Ophyra melliventris Malloch, 1929, Ann. Mag. Nat. Hist., III, p. 550.

Male, Barberton, Transvaal, May 17, 1913 (H. K. Munro).

Malloch described this species from a single female and suggested that it might belong to *Hydrotaea*. The male has the first two abdominal segments yellow, the others black, although the apex of the abdomen is reddish and the third segment is very broadly yellow on one side. There is no evidence of staining. The anterior femora are quite typical of *Hydrotaea*. The species is easily recognized by the partly pale abdomen and the polished black parafrontals, parafacials and cheeks. The occiput and facial depression are cinerous pollinose.

Hydrotaea tersa Wiedemann

Anthomyia tersa Wiedemann, 1830, 'Ausser. Zweifl.,' II, p. 427.

The type locality is unknown but the type specimen is undoubtedly of tropical origin. Length, 7 mm.

MALE.—Head black in ground color, whitish pollinose; frontal lunule and palpi reddish in ground color, the lunule white; frontal vitta black, obliterated or linear for more than half the length of the front; front narrower than the ocellar triangle, with four or five pairs of short, fine bristles on the anterior third; ocellars well developed. Cheeks about one-tenth as wide as eye-height. Antennae reddish; arista practically bare.

Thorax blackish, moderately shining, from posterior view with the mesonotum appearing cinereous pollinose but partly stained so that it is not possible to determine whether there are dark marks on the median third behind the suture. No acrostical bristles; dorsocentrals probably 2–4 but I can make out only the two posterior postsutural pairs. Sternopleurals 1–1. Scutellum cinereous pollinose, with two pairs of strong bristles, the sides bare.

Legs reddish yellow, the tarsi black, the posterior four coxae brownish. Front legs normal for the genus. Posterior tibiae with a tuft of black hairs on the ventral surface beyond the middle, the apical half of this surface with long, soft hair, the anteroventral surface with a row of short, fine brownish bristles on the apical half.

Wings with yellow tinge, the veins yellow. Squamae white. Halteres yellow.

Abdomen reddish yellow, yellowish pollinose, the bases of the segments with paler pollen; apices of second and third segments narrowly black, the fourth black in ground color on the apical half or more, the first with brownish tinged apex. Genitalia brown. Sternites brownish, pale pollinose, the apices paler. Hair and bristles black.

There can be no doubt that this is the type specimen and it is in very good condition although there is a little fungus growth. If the species is from Africa it may be readily distinguished from *melliventris* Malloch by the color of the mesonotum which appears as though it should be unicolorous, the less extensively black abdomen and more robust form.

OPHYRA DESVOIDY

Only two species are known from Africa, one of them occurring also in Europe and Asia.

TABLE OF SPECIES

1.—Lower squamal lobe pale, with blackish border... ......*nigromarginatus* Stein.
2.—Lower squamal lobe without dark border.. ....*capensis* Wiedemann.

Ophyra nigromarginata Stein

STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 193.

Described from Mauritius. Type in Vienna Museum.

Ophyra capensis Wiedemann

Anthomyia capensis Wiedemann, 1818, Zool. Mag., I, pt. 2, p. 46.
Anthomyia anthrax Meigen, 1826, 'Syst. Beschr. Eur. Dipt.,' V, p. 161.
Anthomyia capensis Wiedemann, 1830, 'Ausser. Zweifl.,' II, p. 426.
Ophyra anthrax Malloch, 1923, Ann. Mag. Nat. Hist., XI, p. 666.

Two females, Balla Balla, Southern Rhodesia, February and March, 1931 (A. Cuthbertson); female, New Hanover, Natal, December 1, 1914 (C. B. Hardenberg).

This species has been going under the name *anthrax* despite the fact that *capensis* is the older name.

Ophyra melliventris Malloch belongs to *Hydrotaea.*

PHAONIA DESVOIDY

The following key includes the species I have been able to place in this genus.

TABLE OF SPECIES

1.—Eyes densely haired.................................2.
Eyes bare or nearly so.................................5.
2.—Crossveins bordered with brown....................*obscurinervis* Stein.
Crossveins not bordered with brown.................................3.
3.—Mesonotum cinereous with a broad black postsutural fascia and three presutural spots.................................4.
Mesonotum black, cinereous pollinose with four black vittae..*peregrina* Malloch.
4.—Femora without broad, black apical bands; eyes of male narrowly separated.............*cuthbertsoni*, new species.
Femora with broad, black apical bands; eyes of male widely separated.............*annulipes* Stein.
5.—Two or three pairs of postsutural dorsocentrals.................................6.
Four pairs of postsutural dorsocentrals.................................15.
6.—Only two pairs of postsutural dorsocentrals....................*bieseta* Stein.
Three pairs of postsutural dorsocentrals.................................7.
7.—Anterior tibiae with only the apical bristles.................................9.
Anterior tibiae with a posterior median bristle.................................8.
8.—Abdomen without shining paired spots....................*virgata* Stein.
Abdomen with shining paired spots.................... ♀ *abnormis* Stein.
9.—Abdomen with paired dorsal spots.................................10.
Abdomen without paired dark spots.................................12.
10.—Scutellum grayish with yellow apex....................*flavicornis* Stein.
Scutellum yellow, sometimes with brown spot on either side.................................11.
11.—Scutellum brown on the sides....................*abnormis* Stein.
Scutellum wholly yellow....................*bequaerti*, new species.
12.—Thorax black in ground color.................................14.
Thorax almost all reddish or yellowish in ground color.................................13.
13.—Mesonotum with a black vitta occupying almost the median third, or wholly yellowish....................*vittithorax* Stein.

Mesonotum yellowish with gray pollen and vittae............*suturalis* Stein.

14.—Antennae and palpi blackish..........................*vumbana*, new species.

Antennae and palpi reddish yellow..................*aethiopica*, new species.

15.—Second abdominal segment with a pair of strong marginals; upper frontal bristles much shorter than the ocellars.................*ocellaris* Malloch.

Second abdominal segment without erect median marginals..............16.

16.—Only three pairs of frontal bristles limited to the anterior third; mesonotum without brown vittae..............................*munroi*, new species.

Front with bristles extending to the anterior ocellus, the upper ones stronger than the ocellars...17.

17.—Mesonotum yellow with a black vitta between the acrosticals ....*capensis*, new species.

Mesonotum rusty reddish yellow, with four brownish vittae...*rhodesi* Malloch.

Phaonia annulipes Stein

Aricia annulipes Stein, 1906, Berl. Ent. Zeitschr., LI, p. 33.
Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 477.
Phaonia magnifica Malloch, 1921, Ann. Mag. Nat. Hist., VII, p. 425.
Malloch, 1929, Ann. Mag. Nat. Hist., III, p. 552.

Male, Cookhouse, S. Africa, February 8, 1925; male, Tarkagtad, S. Africa, September 29, 1922 (H. K. Munro).

Phaonia virgata Stein

Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 481.

Female, East London, Cape Province, September 11, 1922; two males and two females, East London, May 5, 9, 1923 (H. K. Munro).

Phaonia vittithorax Stein

Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 479 (Natal).

Female, East London, Cape Province, May 1, 1924; female, East London, April 29, 1923 (H. K. Munro); male, Salisbury, Southern Rhodesia, November, 1934 (A. Cuthbertson).

The female lacks the blackish dorsocentral vitta.

Phaonia abnormis Stein

Spilogaster abnormis Stein, 1906, Berl. Ent. Zeitschr., LI, p. 49.
Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 478.
Malloch, 1921, Ann. Mag. Nat. Hist., VIII, p. 417.
Malloch, 1929, Ann. Mag. Nat. Hist., III, p. 552.

Male, Durban, Natal, July 31, 1917 (collector ?); male, Chirinda Forest, S. Rhodesia, November, 1930; twenty specimens of both sexes, Gurungwe and River Dande, S. Rhodesia, July, 1933, and one male from Vumba Mountains, March, 1935 (A. Cuthbertson).

The female of this species has a median posterior bristle on the anterior tibia, but there is seldom an indication of it in the male.

Phaonia ocellaris Malloch

Malloch, 1929, Ann. Mag. Nat. Hist., III, p. 553.

Male, Isipingo, S. Africa, June 12, 1922 (H. E. Irving).

Phaonia rhodesi Malloch

Malloch, 1929, Ann. Mag. Nat. Hist., III, p. 552.

Female, Betala, Liberia, October 13, 1926 (J. Bequaert).

Phaonia cuthbertsoni, new species

Related to *annulipes* Stein but at once distinguished by the absence of black bands on the apices of the femora, the narrower front of the male, the partly reddish abdomen and the absence of blackish spots on the sides of the abdominal segments. Length, 9 to 9.5 mm.

Male.—Lower half of the head reddish in ground color, the upper half black; pollen whitish, cinereous on the occiput. Front slightly narrower than the ocellar triangle, the reddish-brown vitta obsolete for almost half its length; five pairs of frontals anteriorly and one or two hairs, the parafrontals bare; ocellars long and strong; verticals absent. Cheeks wide; parafacials much narrower than the third antennal segment. Palpi and proboscis blackish. Antennae black, the basal segments brownish yellow; arista long plumose. Eyes moderately pilose.

Thorax dark in ground color, the broad lateral margins in front and the posterior third of the mesonotum, yellowish, the pleural sutures more or less broadly and the anterior third yellowish; pollen cinereous, the mesonotum with three large dull black spots in front of the suture, extending back from the anterior margin and a similarly colored broad fascia immediately behind the suture. Scutellum brown with cinereous yellow pollen on the apex between the bristles. Acrosticals 0–1; dorsocentrals 2–3; prealar more than half as long as the following bristle; sternopleurals 1–2.

Legs reddish yellow, the tarsi blackish; apices of the femora slightly brownish; anterior tibiae without posterior bristle; middle tibia with two posterior bristles.

Wings with grayish-yellow tinge. Squamae white; halteres yellow.

Abdomen with the first segment yellow except in the middle; second segment yellow with a brown median triangle that broadens posteriorly, and a pair of large, indistinct brown lateral spots; third segment with the lateral spots and dorsal triangle united so that there is very little yellow toward either side basally; fourth segment brown with the broad apex reddish yellow. Pollen yellowish, brown on the brown areas. On the under surface the sides of the last two tergites are broadly brown. Fourth segment with two pairs of discals. The hair is black except on the occiput below the neck.

Female.—Front almost as wide as one eye, with six pairs of frontals, the anterior and two upper pairs strong; verticals and outer verticals strong; pleura almost all reddish in ground color, the scutellum with a larger yellow pollinose area apically. The pale part of the abdomen is more restricted and reddish although the pale pollen is similar in extent.

TYPES.—Holotype, male, Vumba Mountains, Southern Rhodesia, October 20, 1935 (A. Cuthbertson). Allotype, female, Vumba Mountains, January 12, 1937 (Major Drysdale). Paratype, male, Vumba Mountains, March, 1935 (A. Cuthbertson).

Phaonia vumbana, new species

Black, with cinereous pollen, the abdomen with a brownish dorsocentral vitta. Length, 7 mm.

MALE.—Head cinereous pollinose. Front about as wide as the ocellar triangle, the velvety black frontal vitta wider than the parafrontals; six pairs of frontals and two hair-like ones above; ocellars rather short, the verticals not developed. Width of cheeks equal to the length of the third antennal segment. Parafacials as wide as the third antennal segment. Palpi blackish. Antennae black, the arista with long rays. Eyes bare or practically so.

Thorax cinereous pollinose, the mesonotum with four abbreviated dark vittae extending back from the anterior margin. Acrosticals 0–1; dorsocentrals 2–3; prealar two-thirds as long as the following bristle; sternopleurals 1–2; a number of hairs in front of the posterior spiracle. Sternopleura shining in front. Scutellum with a row of hairs below the level of the marginals.

Legs black, the femora with thin grayish pollen, their tips reddish; tibiae brownish. Anterior tibiae without posterior bristle, the median pair with two.

Wings with brown tinge, especially anteriorly. Costal spine short. Squamae yellowish, the knobs of the halteres brown.

Abdomen cinereous pollinose, in some lights with brownish dorsocentral vitta; third and fourth segments with row of discals, the second with a row of fine, erect marginals. Hair wholly black.

TYPES.—Holotype, male, and paratype, male, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Phaonia aethiopica, new species

Black, the antennae and palpi pale orange, the femora dull reddish. Length, 6 to 6.5 mm.

FEMALE.—Face, cheeks and frontal vitta reddish or brownish red, the middle of the facial depression black; pollen cinereous, brownish on the parafrontals and cheeks; a dark spot opposite the base of the third antennal segment. Front narrower than one eye; six pairs of frontals, the upper two reclinate; a row of short, bristly hairs on the parafrontals; ocellars moderately long; outer verticals more than half as long as the verticals. Cheeks almost as wide as the length of the third antennal segment. Palpi and antennae pale orange, the arista black, with long rays. Eyes thinly short pilose.

Thorax black with cinereous or brownish cinereous pollen, the mesonotum with four weak darker vittae. Acrosticals 0–1; dorsocentrals 2–3; prealar more than half as long as the following bristle; sternopleurals 1–2; one or two setulae in front of the posterior spiracle. Scutellum cinereous or brownish cinereous pollinose, the lower edge with a few short, fine hairs on the basal half.

Legs reddish or reddish brown, the tibiae at times somewhat darker than the femora; tarsi black. Anterior tibia without posterior bristle, the middle ones with two or three.

Wings with cinereous or luteous tinge; posterior crossvein faintly clouded with brown; costal spine not developed. Squamae tinged with brown and with brown border. Knob of halteres brown.

Abdomen with cinereous or brownish cinereous pollen, the dorsum somewhat darkened along the broad middle; only the fourth segment with discals.

TYPES.—Holotype, female and paratype, female, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Phaonia bequaerti, new species

Related to *abnormis* Stein but readily distinguished by the wholly yellow scutellum and the wider front of the male. Length, 6.5 mm.

MALE.—Head blackish or reddish brown in ground color, the facial ridges and lower occiput yellowish; pollen white, cinereous on the occiput and cheeks. Front almost twice as wide as the ocellar triangle, the reddish-brown vitta exposed on its whole length. Six pairs of frontals, the anterior and upper two moderately strong; ocellars rather short. Cheeks slightly wider than the third antennal segment; parafacials narrow. Palpi and antennae reddish yellow; arista brown with long black rays, the base broadly reddish. Eyes bare.

Thorax reddish yellow, with pale ocher-yellow pollen, the mesonotum in some views with two geminate ferruginous vittae. Acrosticals 0–1; dorsocentrals 2–3; prealar about one-fourth as long as the following bristle; sternopleurals 1–2. Scutellum wholly yellow.

Legs yellowish red, the tarsi brown; front tibiae without posterior bristle, the middle ones with two.

Wings with luteous tinge. Squamae pale yellowish gray. Halteres pale orange.

First and second abdominal segments yellowish, the second with the broad apex, expanded laterally, and a median vitta blackish, the third and fourth blackish, the latter with broadly yellowish apex. Pollen cinereous, the bristles arising from dark spots; second to fourth segments each with paired, brownish or dark spots, those on the second segment large, subtriangular and extending the whole length of the segment, those on the third much smaller and reaching forward only to the middle of the segment; the spots on the fourth segment are broadly separated from the base and apex and are in the form of a pair of narrowly separated brown stripes. Third segment with or without a pair of discals laterally, the fourth with a row.

HOLOTYPE.—Male, Memeh Town, Liberia, August 29, 1926 (J. Bequaert).

Phaonia munroi, new species

Related to *ocellaris* Malloch but readily distinguished by the absence of marginals on the second abdominal segment. Length, 6.5 mm.

MALE.—Head black, white pollinose, the facial ridges and back of the mouth yellow; pollen of occiput and cheeks gray. Front very narrow, the black vitta showing only anteriorly; three pairs of frontals in front, the front pair moderately strong; a pair of hair-like bristles in front of the ocelli, the ocellars long; verticals scarcely developed. Cheeks about as wide as the third antennal segment. Palpi and antennae reddish yellow; arista and its long rays black, the base broadly yellowish. Eyes bare.

Thorax reddish yellow, with pale ocher-yellow pollen, the mesonotum with four slightly darker vittae. Dorsocentrals 2–4; acrosticals 0–1; prealar fully half as

TYPES.—Holotype, male, Vumba Mountains, Southern Rhodesia, October 20, 1935 (A. Cuthbertson). Allotype, female, Vumba Mountains, January 12, 1937 (Major Drysdale). Paratype, male, Vumba Mountains, March, 1935 (A. Cuthbertson).

Phaonia vumbana, new species

Black, with cinereous pollen, the abdomen with a brownish dorsocentral vitta. Length, 7 mm.

MALE.—Head cinereous pollinose. Front about as wide as the ocellar triangle, the velvety black frontal vitta wider than the parafrontals; six pairs of frontals and two hair-like ones above; ocellars rather short, the verticals not developed. Width of cheeks equal to the length of the third antennal segment. Parafacials as wide as the third antennal segment. Palpi blackish. Antennae black, the arista with long rays. Eyes bare or practically so.

Thorax cinereous pollinose, the mesonotum with four abbreviated dark vittae extending back from the anterior margin. Acrosticals 0–1; dorsocentrals 2–3; prealar two-thirds as long as the following bristle; sternopleurals 1–2; a number of hairs in front of the posterior spiracle. Sternopleura shining in front. Scutellum with a row of hairs below the level of the marginals.

Legs black, the femora with thin grayish pollen, their tips reddish; tibiae brownish. Anterior tibiae without posterior bristle, the median pair with two.

Wings with brown tinge, especially anteriorly. Costal spine short. Squamae yellowish, the knobs of the halteres brown.

Abdomen cinereous pollinose, in some lights with brownish dorsocentral vitta; third and fourth segments with row of discals, the second with a row of fine, erect marginals. Hair wholly black.

TYPES.—Holotype, male, and paratype, male, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Phaonia aethiopica, new species

Black, the antennae and palpi pale orange, the femora dull reddish. Length, 6 to 6.5 mm.

FEMALE.—Face, cheeks and frontal vitta reddish or brownish red, the middle of the facial depression black; pollen cinereous, brownish on the parafrontals and cheeks; a dark spot opposite the base of the third antennal segment. Front narrower than one eye; six pairs of frontals, the upper two reclinate; a row of short, bristly hairs on the parafrontals; ocellars moderately long; outer verticals more than half as long as the verticals. Cheeks almost as wide as the length of the third antennal segment. Palpi and antennae pale orange, the arista black, with long rays. Eyes thinly short pilose.

Thorax black with cinereous or brownish cinereous pollen, the mesonotum with four weak darker vittae. Acrosticals 0–1; dorsocentrals 2–3; prealar more than half as long as the following bristle; sternopleurals 1–2; one or two setulae in front of the posterior spiracle. Scutellum cinereous or brownish cinereous pollinose, the lower edge with a few short, fine hairs on the basal half.

Legs reddish or reddish brown, the tibiae at times somewhat darker than the femora; tarsi black. Anterior tibia without posterior bristle, the middle ones with two or three.

Wings with cinereous or luteous tinge; posterior crossvein faintly clouded with brown; costal spine not developed. Squamae tinged with brown and with brown border. Knob of halteres brown.

Abdomen with cinereous or brownish cinereous pollen, the dorsum somewhat darkened along the broad middle; only the fourth segment with discals.

TYPES.—Holotype, female and paratype, female, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Phaonia bequaerti, new species

Related to *abnormis* Stein but readily distinguished by the wholly yellow scutellum and the wider front of the male. Length, 6.5 mm.

MALE.—Head blackish or reddish brown in ground color, the facial ridges and lower occiput yellowish; pollen white, cinereous on the occiput and cheeks. Front almost twice as wide as the ocellar triangle, the reddish-brown vitta exposed on its whole length. Six pairs of frontals, the anterior and upper two moderately strong; ocellars rather short. Cheeks slightly wider than the third antennal segment; parafacials narrow. Palpi and antennae reddish yellow; arista brown with long black rays, the base broadly reddish. Eyes bare.

Thorax reddish yellow, with pale ocher-yellow pollen, the mesonotum in some views with two geminate ferruginous vittae. Acrosticals 0–1; dorsocentrals 2–3; prealar about one-fourth as long as the following bristle; sternopleurals 1–2. Scutellum wholly yellow.

Legs yellowish red, the tarsi brown; front tibiae without posterior bristle, the middle ones with two.

Wings with luteous tinge. Squamae pale yellowish gray. Halteres pale orange.

First and second abdominal segments yellowish, the second with the broad apex, expanded laterally, and a median vitta blackish, the third and fourth blackish, the latter with broadly yellowish apex. Pollen cinereous, the bristles arising from dark spots; second to fourth segments each with paired, brownish or dark spots, those on the second segment large, subtriangular and extending the whole length of the segment, those on the third much smaller and reaching forward only to the middle of the segment; the spots on the fourth segment are broadly separated from the base and apex and are in the form of a pair of narrowly separated brown stripes. Third segment with or without a pair of discals laterally, the fourth with a row.

HOLOTYPE.—Male, Memeh Town, Liberia, August 29, 1926 (J. Bequaert).

Phaonia munroi, new species

Related to *ocellaris* Malloch but readily distinguished by the absence of marginals on the second abdominal segment. Length, 6.5 mm.

MALE.—Head black, white pollinose, the facial ridges and back of the mouth yellow; pollen of occiput and cheeks gray. Front very narrow, the black vitta showing only anteriorly; three pairs of frontals in front, the front pair moderately strong; a pair of hair-like bristles in front of the ocelli, the ocellars long; verticals scarcely developed. Cheeks about as wide as the third antennal segment. Palpi and antennae reddish yellow; arista and its long rays black, the base broadly yellowish. Eyes bare.

Thorax reddish yellow, with pale ocher-yellow pollen, the mesonotum with four slightly darker vittae. Dorsocentrals 2–4; acrosticals 0–1; prealar fully half as long as the following bristle; sternopleurals 2–2, the lower anterior very weak. Scutellum wholly yellowish.

Legs yellowish, the tarsi black; anterior tibiae without posterior bristle, the middle pair with two.

Wings cinereous hyaline, with very short costal spine. Squamae cinereous. Halteres yellow.

Basal two abdominal segments, and the base of the third laterally, yellow, the third and fourth brown; pollen cinereous yellow, becoming more brownish on the apical segments. Under surface almost all reddish yellow.

HOLOTYPE.—Male, Prospect, South Africa, March 19, 1923 (H. K. Munro). Returned to Mr. Munro.

Phaonia capensis, new species

Related to *rhodesi* Malloch but with a black vitta between the acrosticals. Length, 7 mm.

MALE.—Head black in ground color, white pollinose, the occiput cinereous; facial ridges obscurely yellowish. Front as wide as the ocellar triangle, with seven or eight pairs of strong frontals, the upper two or three reclinate; ocellars weak; verticals scarcely developed. Cheeks a little wider than the third antennal segment. Palpi and antennae reddish yellow, the arista mostly brown, the rays long. Eyes bare.

Thorax yellowish, with a black vitta lying between the acrostical setulae, the sides of the scutellum with large brown spot. Acrosticals 0–1; dorsocentrals 2–4; prealar about one-fourth as long as the following bristle; sternopleurals 1–2. Pollen whitish, thin on the disc of the mesonotum.

Legs yellowish, the tarsi somewhat darkened apically. Front tibia without a bristle, the middle ones with two on the posterior surface.

Wings cinereous hyaline, the crossveins lightly clouded with brown. Squamae cinereous. Halteres yellow.

Abdomen yellow, the second segment with a pair of dorsal and lateral brown spots posteriorly; third segment and basal two-thirds of the fourth brown, the third with a pair of large, shining brown spots on the apical half or more. Pollen brown, thin and whitish on the yellow portions. Second and third segments with distinct discals, the fourth with a row; second segment with a row of weak, appressed apicals. Under surface almost all yellowish. Hair black.

HALOTYPE.—Male, East London, South Africa, August, 1924 (H. K. Munro).

HELINA DESVOIDY

The genus *Helina*, as at present understood, contains a large number ot species, many of which can be segregated into rather homogeneous groups. However, the division of the genus appears to be unwarranted because of the many connectant forms between any groups established. The African species known to me are included in the following key.

TABLE OF SPECIES

1.—Anterior coxae reddish or yellow in ground color........................2.
Anterior coxae mostly or wholly black in ground color....................7.

2.—Abdomen entirely yellow........................*cuthbertsoni,* new species.
Abdomen with blackish or brown markings...........................3.
3.—Mesonotum cinereous with a broad black median fascia..........*lucida* Stein.
Mesonotum without black fascia.......................................4.
4.—Mesonotum partly shining ferruginous or castaneous.....*castanea,* new species.
Mesonotum yellowish, with or without dark vittae......................5.
5.—Prealar bristle about one-third as long as the following bristle................
....*inferior,* new species.
Prealar almost two-thirds as long as the following bristle..................6.
6.—Eyes of male separated by less than the width of the ocellar triangle...........
....*subsetosa,* new species.
Front of male distinctly wider than the ocellar triangle..*rhodesiana,* new species.
7.—Crossveins broadly clouded with brown..................*plurinotata* Stein.
Crossveins not conspicuously clouded.................................8.
8.—Front tibiae with a posterior bristle near the middle....................10.
Front tibiae with only the apical bristles................................9.
9.—Femora reddish...................................*versatilis,* new species.
Femora black..*quadriseta* Adams.
10.—Mesonotum black with two broad cinereous vittae.........*lenta,* new species.
Mesonotum cinereous, weakly dark vittate.................*latifrons* Adams.

Helina cuthbertsoni, new species

Black, the abdomen and legs yellow; third antennal segment whitish; tarsi brown. Length, 5 mm.

Male.—Head black in ground color, whitish pollinose, the occiput cinereous; frontal vitta obsolete for most of its length; one strong pair of frontals immediately above the antennae and an additional weaker pair; ocellars moderately long. Cheeks narrow, black-haired except above. Parafacials linear. Proboscis brown; palpi yellow. Basal antennal segments reddish, the third very pale yellowish, almost whitish; arista brown, with long brown rays, the basal third yellow. Eyes bare.

Thorax black, cinereous white pollinose, from dorsal view entirely shining or at most slightly whitish. Dorsocentrals 2–3; acrosticals 0–1; prealar absent; two pairs of marginal scutellars; sides of scutellum bare; sternopleurals 1–2; hair black.

Legs, including the coxae yellow, the tarsi blackish; posterior femora with three strong anteroventral bristles apically and a row of fine, posteroventral bristles on the basal three-fifths; anterior tibiae without median bristles; middle tibiae with two short posterior bristles, the posterior pair with a short anterodorsal bristle near the middle and one on the posteroventral surface near the apical third.

Wings cinereous hyaline; veins brownish, yellow at the base of the wing; fourth vein straight. Squamae and halteres yellow.

Abdomen yellow, slightly shining, from posterior view with thin whitish pollen, the hairs and bristles black. Second to fourth segments each with a row of marginals, the fourth with a row of discals across the middle.

Types.—Holotype, male and one male paratype, Balla Balla, Southern Rhodesia, February, 1933 (A. Cuthbertson).

Helina lucida Stein

Mydaea lucida Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 493 (Transvaal).

Male and female, Pretoria, Transvaal, August 20, 1912, and February 25, 1913 (H. K. Munro); male, Salisbury, Southern Rhodesia, August, 1929 (A. Cuthbertson).

Helina castanea, new species

Reddish yellow and castaneous, the squamae grayish brown. Length, 7 to 7.5 mm.

MALE.—Head reddish in ground color, the upper half of the occiput black; pollen white, cinereous or cinereous brown on the occiput. Front linear, the vitta obsolete on about half its length; three pairs of frontals anteriorly and a pair of hairs in front of the ocelli; ocellars long. Verticals and outer verticals slightly differentiated. Cheeks somewhat wider than the third antennal segment; parafacials very narrow. Palpi and antennae pale orange, the brown arista long plumose. Eyes bare.

Thorax reddish, the dorsum castaneous brown, the pleura in part reddish brown, the sides of the mesonotum yellow in front of the suture. From posterior view the mesonotum is yellowish pollinose in front of the suture with three dark vittae, the median one narrow and not reaching the suture, the outer ones very broad; behind the suture there are three pale pollinose vittae, all of about equal width; pleura cinereous pollinose, the scutellum with pale pollen apically. Acrosticals 0–1; dorsocentrals 2–4; prealar two-thirds as long as the following bristle; sternopleurals 2–2.

Legs reddish yellow, the tarsi black, the apices of the posterior four femora sometimes broadly reddish brown. Anterior tibiae without posterior bristle.

Wings rather strongly tinged with brown; costal spine quite short and appressed, third vein usually with two fine setulae near the base on the lower surface. Squamae grayish brown with brown rim. Halteres yellow.

First abdominal segment reddish yellow or reddish, the second brown with the base narrowly pale, the apical segments dark brown. Pollen brownish yellow, white on the bases of the segments except medianly, the second and third segments each with a pair of large, nearly bare spots in some views. Third segment with two or three discals laterally, the fourth with a row.

FEMALE.—Front wide, brownish red, with five pairs of frontals, of which only the anterior pair is strong. There are only three sternopleurals in the single specimen of this sex.

TYPES.—Holotype, male, allotype, female, and paratype, male, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Helina inferior, new species

Dull reddish yellow, the abdomen dark on the apical half or more. Length, 6 to 7 mm.

MALE.—Head black in ground color, the facial ridges and the occiput behind the mouth yellow; pollen white, cinereous on the occiput. Front much narrower than the ocellar triangle, the black vitta exposed for less than half its length; four pairs of frontals anteriorly and a pair of hairs in front of the ocelli; ocellars moderately long; verticals very feebly developed. Cheeks somewhat wider than the third antennal segment; parafacials linear. Palpi and antennae reddish yellow; arista yellow basally, with long black rays. Proboscis brownish red to yellow. Eyes bare.

Thorax yellowish, the dorsum somewhat darker; pollen pale yellowish on the pleura, cinereous yellow dorsally; mesonotum with four obscure brownish-red vittae, visible from behind. Acrosticals 0–1; dorsocentrals 2–4; prealar less than one-third as long as the following bristle; sternopleurals 1–2. Scutellum with a few irregularly placed hairs below the laterals.

Legs reddish yellow, the tarsi becoming brownish red apically. Anterior tibiae without posterior median bristle.

Wings cinereous hyaline; third vein with two tiny setulae near the base on the under surface. Costal spine very small. Squamae grayish yellow, with pale border. Halteres yellow.

First abdominal segment and the base of the second laterally, yellow, the dorsum of the abdomen otherwise blackish in ground color. Pollen rather thick, cinereous; a pair of large, brownish spots on the second to fourth segments and an interrupted broad median vitta. Third segment with two or three pairs of discals laterally, the fourth with a row. Sternites and genitalia yellow. The brown markings are not sharply limited.

FEMALE.—Face wholly yellow in ground color. Front dull orange, with a darker, slightly shining triangle extending forward to the anterior third; five or six pairs of frontals, the upper two moderately strong and reclinate, the anterior pair long and strong; ocellars long; outer verticals almost as long as the verticals. Pollen of mesonotum somewhat paler, the vittae less distinct.

TYPES.—Holotype, male, allotype, female, and paratype, female. Barberton, South Africa, May 21 and 15, 1913 and 1914 (H. K. Munro). Types returned to Mr. Munro.

Helina subsetosa, new species

Rusty reddish yellow, the mesonotum with a grayish median vitta, the abdomen brown on the apical half. Length, 6.5 mm.

MALE.—Head black in ground color, the face, upper part of the cheeks and the occiput above the oral opening, reddish or yellowish. Pollen white, cinereous on the occiput. Front very narrow, with three pairs of frontals anteriorly and a pair of hairs in front of the ocelli; ocellars long; verticals scarcely differentiated. Frontal vitta brownish red, obsolete for half its length. Cheeks slightly wider than the third antennal segment; parafacials linear. Palpi yellowish. Antennae dull orange, the third segment broadly blackish apically; arista long plumose, black, with the base very broadly yellowish.

Thorax yellow with whitish pollen, the mesonotum pale orange with a broad median blackish vitta that extends well onto the scutellum, the pollen yellowish, but gray on the dark vitta; four narrow and not prominent rusty reddish vittae, the inner ones bordering the dark stripe. Acrosticals 0–1; dorsocentrals 2–4; prealar almost two-thirds as long as the following bristle; sternopleurals 1–2. Hair wholly black. The dorsum of the scutellum is practically all gray, the sides and apex pale.

Legs reddish yellow, the anterior tibiae without median bristle, the posterior femora with only five or six antero-ventral bristles. Tarsi black. Anterior coxae wholly black haired.

Wings cinereous hyaline; costal spine small and appressed; third vein with two setulae near the base on the under surface. Squamae cinereous hyaline, with pale border. Halteres yellow.

First two abdominal segments yellowish,the second with a pair of faint darker spots; third and fourth brownish above, with mostly brownish tinged pollen, and with indications of paired, brown spots; pollen on basal segments cinereous or cinereous yellow. Third segment with two or three pairs of discals toward the sides, the fourth with an interrupted row. Apex of abdomen yellowish, the venter yellow; hair black.

HOLOTYPE.—Male, Salisbury, Southern Rhodesia, February 12, 1935, No. 4036 (A. Cuthbertson).

Helina rhodesiana, new species

Rusty reddish yellow, the mesonotum with a median gray vitta; abdomen partly blackish. Length, 7 to 7.5 mm.

MALE.—Head black in ground color, the facial depression more or less extensively yellow, the ridges reddish or yellowish; pollen white, cinereous on the occiput. Front distinctly wider than the ocellar triangle, the black vitta obsolete for more than one-third its length; four or five pairs of frontals anteriorly and a pair of hairs in front of the ocelli; ocellars long; verticals scarcely developed. Cheeks conspicuously wider than the third antennal segment; parafacials quite narrow. Palpi and antennae pale orange; arista black, long plumose, the base broadly yellow. Proboscis brown and brownish red. Eyes bare.

Thorax yellow, the dorsum reddish yellow, with a broad black median vitta extending onto the scutellum but sometimes abbreviated in front. Pollen whitish, grayish on the dark vitta, a linear brown vitta overlies the posterior half of the gray stripe. Acrosticals 0–1; dorsocentrals 2–4; prealar almost two-thirds as long as the following bristle; sternopleurals normally 1–2, a weak one sometimes present below the anterior bristle. Dorsum of the scutellum almost wholly dark, the sides and apex pale. Hair wholly black.

Legs reddish yellow or yellow; the tarsi black; anterior tibiae without median bristle; posterior femora with five or six anteroventral bristles. Front coxae with fine yellow hairs in addition to the strong black hairs and bristles.

Wings with cinereous yellow tinge; costal spine small and appressed; third vein with two setulae below near the base. Squamae rather whitish, with pale border. Halteres yellow.

Basal two abdominal segments yellowish in ground color, the second with a pair of brownish spots posteriorly near the middle; third and fourth segments blackish or brown in ground color, the abdominal pollen cinereous, the apical segments each with paired brownish spots which are not conspicuous; bristles mostly arising from brown spots. Third segment with broadly interrupted row of discals, the fourth with complete row. Apex of abdomen and the sternites yellowish.

TYPES.—Holotype, male, and paratype, male, Gurungwe, Southern Rhodesia, July, 1933 (A. Cuthbertson).

Helina plurinotata Stein

Mydaea plurinotata STEIN, 1914, 'Voy. Allauad and Jeann., Dipt.,' p. 111 (Br. E. Afr.).

Five males and one female, Addis Ababa, Abyssinia, July 18, 19, 1920 (B. Brown).

In his check list of Muscidae, Stein placed this species as a synonym of *trimaculata* Stein. If I have correctly placed the species, the two are very distinct, *trimaculata* belonging to *Idiopygus* Malloch. The present species is a typical *Helina* and has the fifth sternite with a deep V-shaped apical emargination.

Helina quadriseta Adams

Spilogaster quadriseta Adams, 1905, Kans. Univ. Sci. Bull., III, p. 203.

Female, New Hanover, South Africa, August, 1914 (C. B. Hardenberg); female, Lake Side, Cape Province, May 25, 1927 (H. K. Munro).

This is a small species with short but distinct prealar bristle and paired abdominal spots. The types are in the University of Kansas.

Helina versatilis, new species

Black, with cinereous pollen, the legs mostly reddish; abdomen with paired spots. Length, 6 to 7 mm.

Male.—Head black in ground color, cinereous white pollinose, the occiput cinereous. Front slightly wider than the ocellar triangle, the black vitta distinct on its whole length; eight or nine pairs of frontals which decrease in length posteriorly, those in front of the ocelli hairlike and very short; ocellars long; verticals not developed. Cheeks twice as wide as the third antennal segment, the parafacials about three-fourths as wide. Palpi and antennae blackish; the arista with moderately long rays.

Thorax black, cinereous pollinose, the mesonotum with four narrow blackish brown vittae, the posterior half of the mesonotum and the scutellum sometimes with brownish-yellow pollen. Scutellum wholly black in ground color or with the apex more or less broadly dark reddish, the apical half sometimes reddish. Acrosticals 0–1; dorsocentrals 2–4; prealar very weak, sometimes scarcely differentiated; sternopleurals 2–2.

Legs reddish, the coxae and tarsi black, the former cinereous pollinose; anterior femora almost all black, with cinereous pollen. Anterior tibiae without posterior bristle.

Wings cinereous hyaline, with more or less brown tinge; costal spine appressed. Squamae grayish white. Halteres yellow.

Abdomen thickly cinereous pollinose, the second and third segments each with rather small, brown, paired spots. Third segment with a few discals laterally, the fourth with an interrupted row. Genitalia sometimes partly reddish.

Types.—Holotype, male, paratypes, two males, Salisbury, Southern Rhodesia, November 11, 1936 and September, 1936 (A. Cuthbertson).

This species greatly resembles *latifrons* Adams but is larger, lacks the bristle on the front tibiae and has many more frontal bristles. It is readily distinguished from *quadriseta* Adams, of which I have seen the type, by its larger size and reddish legs.

Helina latifrons Adams

Spilogaster latifrons Adams, 1905, Kans. Univ. Sci. Bull., III, p. 204.
Mydaea acuta Stein, 1913, Ann. Mus. Nat. Hung., XI, p. 503 (Abyssinia, Natal).

Eight specimens of each sex, Barberton, Transvaal, May, 1913, 1914; male and three females, Pretoria, Transvaal, February, 1912, April and May, 1919; two females, East London, Cape Province, February 15, 16, 1919; male, Peddie, South Africa, September 27, 1921 (H. K. Munro); two males and a female, Salisbury, Southern Rhodesia, January, May and September, 1929; two females, Lomagundi, Southern Rhodesia, May, 1931 (A. Cuthbertson); also four types of *latifrons*, male and female, Bindura, Southern Rhodesia, May, 1932; three females, Victoria Falls, Southern Rhodesia, June 3, 1932; four females, Salisbury, Southern Rhodesia, April and June 15, 1932 (A. Cuthbertson).

The legs vary in color, sometimes only the tibiae being reddish, at other times the femora reddish with the anterior pair mostly black.

Helina lenta, new species

Black, the mesonotum with two whitish vittae divided by a brown one; wings tinged with brown. Length, 6 mm.

MALE.—Head and appendages wholly black; pollen white on the face and cheeks, cinereous on the occiput, with brown tinge on the linear parafrontals. Front as wide as the ocellar triangle, the vitta opaque black; four pairs of frontals confined to the anterior half; ocellars broken off. Cheeks about twice as wide as the third antennal segment. Arista long plumose. Eyes bare.

Thorax wholly black in ground color. Lower half of the pleura cinereous pollinose, the upper half mostly brown. Mesonotum with a pair of broad, cinereous white vittae separated by a brown one that is margined with opaque black on the anterior half; lateral margins broadly cinereous except posteriorly, the space between the dorsocentral and lateral pale vittae appears black from dorsal view but is brown pollinose and appears brown from lateral view. The dorsocentral vittae are scarcely evident from anterior view. Scutellum cinereous, with narrow, brown triangle on the basal half. Prescutellar acrosticals weak; dorsocentrals 2–3; prealar absent; sternopleurals 2–2.

Legs black, the tibiae brownish; front tibiae with a distinct median bristle; hind tibiae with three anterodorsal and two anterior bristles.

Wings tinged with brown; costal spine small and appressed. Squamae translucent grayish, with pale yellowish border. Halteres yellow.

Abdomen with grayish-brown pollen; the second and third segments each with pair of small dark spots and there is a weak, interrupted median brown vitta. The abdominal hair is erect and there are discals on the third and fourth segments.

HOLOTYPE.—Male, Burunga, Congo (J. Bequaert).

I place this species tentatively in *Helina*. The absence of the prealar bristle and the very weak prescutellars indicate that it possibly belongs elsewhere.

SPILARIA SCHNABLE AND DZIEDZICKI

This genus differs from *Helina* in having hair beneath the posterior spiracle. Examples of three of the five recognized species are before me.

TABLE OF SPECIES

1.—Palpi black..3.
Palpi red to dark brownish red..2.
2.—Abdomen yellowish in ground color, with darker paired spots......*rufina* Stein.
Abdomen black in ground color........................ *punctifer* Malloch.
3.—Posterior crossvein almost evenly infuscated on its whole length, or scarcely clouded..4.
Posterior crossvein with a roundish, brown spot at either end................ ....*innubilifera* Malloch.
4.—Abdomen reddish yellow in ground color; antennae pale yellow....*rufina Stein*
Abdomen blackish in ground color; antennae mostly black.................5.
5.—Third antennal segment about four times as long as the second..*africana* Malloch.
Third segment much less than three times as long as the second....*mollis* Stein.

Spilaria rufina Stein

Spilogaster rufina STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 48.
Mydaea rufina STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 499.

Female, Barberton, Transvaal, May 19, 1920 (H. K. Munro); two females, Durban, Natal, April 9, 1921 and July 9, 1924 (collector ?); male, Betala, Liberia, October 13, 1926 (J. Bequaert).

Spilaria punctifer Malloch

MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 227.
MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 449.

Female, East London, Cape Province, March 4, 1923 (H. K. Munro); 2 females, Inyanga, Southern Rhodesia, November, 1933 (A. Cuthbertson).

Spilaria mollis Stein

Spilogaster mollis STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 55 (S. Africa).
Mydaea hirticeps STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 486, (Natal, Southern Rhodesia).
MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 227.

Two males, Elliot, South Africa, May 12, 1924; male, Pretoria, Transvaal, August 13, 1913 (H. K. Munro); male and female, P'stroom, S. Africa, August 17, 1910; female, New Hanover, Natal, August 12, 1913 (Geo. C. Maines); male, New Hanover, September 11, 1915 (C. B. Hardenberg); female, Pretoria, June 19, 1919 (collector ?); male, Pretoria, January 23, 1927 (D. Webber); female, Bloemfontein, Orange River Province, August 10, 1917 (collector ?); three males, one female, Salisbury, S. Rhodesia, September, 1929 and September 20, 1932 (A. Cuthbertson).

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NEW AMERICAN DIPTERA

BY C. H. CURRAN

In the following pages descriptions of a number of new American flies are contained. Unless otherwise stated the types are in The American Museum of Natural History.

Syrphidae

Volucella pinkusi, new species

Related to *cinctiventris* Curran but with black-haired thorax. Length, 10 mm.

MALE.—Head black in ground color, the occiput, middle of face above and the sides of the face cinereous pollinose; an incomplete stripe separates the face and cheeks while another yellow stripe crosses the cheek and extends anteriorly along the oral margin. Pile yellow, brown on the eyes and black on the vertical and frontal triangles. Face moderately produced downward, the tubercle large. Antennae brownish red, the arista black on the apical half and with black rays; third segment regular in outline, gently tapering, twice as long as wide.

Thorax blackish green, the disc of the mesonotum with a watery greenish opalescence. Humeri and posterior calli yellowish, the pleural sutures mostly reddish; scutellum dull reddish yellow, with deep, transverse preapical depression. Hair and bristles black, the mesonotum with mostly yellowish pile in front of the suture.

Legs black, only the knees narrowly reddish.

Wings pale brownish, paler posteriorly; marginal cell closed just before the costa.

Abdomen brownish with very strong green and violaceous reflections, the first segment dull yellowish, the second dull reddish with a median vitta, posterior border and sides dark. Pile black. Venter dark green and violaceous, the genitalia black; first sternite mostly yellowish, pile black, yellow at the base.

TYPES.—Holotype, male, and two paratypes, males, St. Anne, Trinidad, August 20, 1933 (A. S. Pinkus).

Baccha abata, new species

Readily distinguished from *placiva* williston by the long-haired scutellum and abdominal markings. Length, 10.5 mm.

FEMALE.—Front shining black with the sides very broadly reddish yellow in front of the ocelli, the upper fourth dulled by brownish pollen; pile black.

Occiput black in ground color, gray pollinose, the pile yellow; upper occipital cilia black. Cheeks and face reddish yellow and with yellow pile; facial tubercle moderately strong, the face strongly receding below the tubercle. Antennae reddish, the third segment broadly brown above; arista black; third segment about as wide as long, the apex obtusely rounded.

Mesonotum black with strong bronze reflection, with a linear median and a pair of rather broad sub-median reddish-brown pollinose vittae; broad sides and scutellum yellowish; pile brownish yellow, black posteriorly and on the scutellum; yellow on the sides and pleura; no distinct ventral scutellar fringe. Pleura reddish yellow, very broadly black posteriorly; mesosternum below and the metanotum black.

Legs reddish; posterior femora with a faint brown band on the apical fourth, their tibiae with one on the basal third and a darker band covering almost the apical third; pile yellow, black on the middle femora and on the posterior femora and tibiae.

Wings tinged with brown; the subcostal cell brown. Apical crossvein sinuous.

Abdomen brownish black, the first segment mostly yellowish. Second segment with the broad sides reddish on the anterior three-fourths and with a small, subtriangular yellow spot behind the middle toward each side; on the posterior half with an opaque black triangle that is broadly separated from the posterior and lateral margins. Third segment with a broad black median vitta beginning at the basal fifth and extending to the apical fourth where it expands forming a broad, incomplete opaque fascia; in front of the posterior arms of the opaque fascia is an obscurely kidney-shaped yellow spot. Fourth segment with a broad, median opaque black vitta on the anterior two-thirds and a subtriangular opaque black spot lying mostly behind the middle of the segment and projecting triangularly forward into a very broad yellow spot that extends backward from the base of the segment. The yellow spot widens posteriorly so that it forms a very rugged Y. On the fifth segment there are three opaque black vittae, the median one extending from the base to the apical fourth, the sub-lateral ones abbreviated at both ends; between them there lies a yellow vitta extending from the base to beyond the middle of the segment; sixth segment wholly shining brownish. Pile short and black; long and yellow on the sides of the first segment. Venter mostly yellowish; first sternite wholly yellow, the second with a narrow median vitta and the sub-apical half brown; third sternite apparently almost all yellowish, the fourth with a preapical fascia and lateral triangle that do not reach the base of the segment, black; fifth sternite with large lateral triangles of black, the sixth wholly yellow.

HOLOTYPE.—Female, C. de Jordao, São Paulo, Brazil, January 3, 1936 (F. Lane).

Eristalis fasciculata, new species

Related to *meigenii* Wiedemann but the scutellum is shining reddish brown, semitranslucent; there is a pair of obscure ashy spots in front of the scutellum and the posterior trochanters of the male bear a tuft of yellow hair posteriorly. Length, 9 to 10.5 mm.

MALE.—Face densely grayish or grayish-yellow pollinose and with yellow pile, a shining black vitta extending from the oral margin to the upper end of the tubercle. Frontal triangle thickly reddish-brown pollinose and black pilose, a shining black, low tubercle immediately above the reddish lunula. Vertical triangle dull black, with pale pollen in front of the ocelli, the pile black. Occiput subopaque black above, cinereous white on the lower three-fourths, the pile yellowish white; some long black hairs above along the orbits. Cheeks broadly shining black in front.

Antennae blackish, arista bare. Eyes touching for a distance equal to the width of the ocellar triangle, thickly brown pilose, the pile becoming pale below.

Mesonotum opaque black or brownish, the sides with more or less steel-blue tinge in some views; suture narrowly bordered with whitish pollen; a pair of whitish pollinose spots visible in front of the scutellum from anterior view; pile black posteriorly but mostly yellow in front of the suture. Scutellum shining brownish red to reddish brown, the sides darker, the pile black except on the sides. Pleura with bluish tinge, thinly clothed with cinereous white pollen and wholly pale yellow pilose.

Legs black, the tibiae brownish; apices of the anterior four femora and the basal third or more of their tibiae yellow; apices of posterior femora brown, the base of their tibiae yellow; first segment of the middle tarsi reddish. Pile yellowish, black on the apical four segments of the tarsi. Posterior trochanters with fascicle of yellow hair.

Wings hyaline with brown veins. Stigmal spot brown, the submarginal cell luteous, stem of second vein black setulose above.

Abdomen opaque black, with pale reddish-yellow markings and shining metallic fasciae. First segment shining black beneath the scutellum. Second with a large, subtriangular reddish-yellow spot on each side extending from the base to the apex and broadly produced inwardly at the middle of the segment, the lateral margin of the segment narrowly black on the apical two-thirds. Third segment with a large, basal rectangular yellow spot on each side, extending to the apical third; across the middle with an aeneous band that is broadly interrupted on the inner part of the yellow ground and usually narrowly interrupted by opaque black in the middle. Fourth segment with an entire black or aeneous fascia across the middle. Apices of the second to fourth segments yellow. Pile black, yellow on the first segment, basal half of the second (except at the sides, where the black pile extends forward to the basal third) on the sides of the following segments, on the genitalia and whole under surface. Genitalia shining black.

Female.—The abdomen may be all black but the second segment is usually marked as in the male; when all black the usually pale areas have a slight grayish sheen and are replaced behind by a broad opaque black fascia, the apices of the segments narrowly yellow. The shining fasciae may be narrowly interrupted in the middle or entire; the fifth segment is shining black on the apical two-thirds. Front of moderate width, widening on the anterior two-thirds, gray pollinose with a more or less entire band of brown pollen immediately above the antennae and with three opaque black spots above, one covering the large ocellar triangle and one on either side in front of the ocelli. The frontal pile and that behind the eyes on the upper fifth is wholly black.

Types.—Holotype, male, allotype, female, São Paulo, Brazil, November, 1936 (J. Lane). Paratypes, two males and four females, same data.

In the key published in Bull. Amer. Mus. Nat. Hist., LXVI, p. 407, this species traces to *assimilis* Macquart, couplet 58. It differs in many respects, but the blackish scutellum at once distinguishes it.

In the couplet mentioned the name *philippii* Schiner should be replaced by *elegans* Blanchard, the two names referring to the same species. In couplet 41 of the same key *urotaenia* Curran should be replaced by *taenia* Wiedemann.

Otitidae

Euxesta pechumani, new species

Differs from *costalis* Fabricius in having the median brown fascia on the wing much narrower and rarely extending behind the third vein, the apex of the abdomen of the female is not yellowish and the front of both sexes is narrower. Differs from *mitis* Curran (Puerto Rico) in having the median brown fascia on the wing narrow, as well as in other respects. Length, 3.5 to 4 mm.

MALE.—Head black, sometimes with strong bluish-green reflections on the bare areas. Front almost one-half longer than wide, reddish, with the vertex, lateral triangles and the ocellar triangle shining black, sometimes brownish red above the middle; hair coarse and black; a white pollinose fascia extends across the middle, consisting of a narrow triangle along each orbit and a very shallow W-shaped mark connecting them. Posterior orbits white pollinose, broadly so below. Upper half of the face and the parafacials and cheeks white pollinose, the parafacials and cheeks reddish in ground color; oral margin and clypeus shining black, the latter sometimes with slight reddish tinge in the middle. Palpi black. Antennae reddish, the third segment very broadly brown above; arista black.

Thorax shining aeneous or with bluish reflections, the color somewhat concealed by cinereous white pollen; scutellum blackish, slightly dulled on the disc.

Legs blackish or brownish, the trochanters, knees, tips of the tibiae and the basal tarsal segment yellowish, the tibiae brownish, but the middle pair may be of a brownish-yellow color.

Wings hyaline, with a very narrow brown fascia before the middle extending from the costa to the third vein, rarely to the fourth, and a large, subtriangular brown spot apically, this latter extending back to the middle of the apical cell. Squamae whitish; knobs of halteres reddish.

Abdomen shining black with metallic greenish or a coppery reflection; hair black.

FEMALE.—Agrees with the male. The ovipositor is black and there is no trace of yellow on the abdomen.

TYPES.—Holotype, male, Bronx, New York City, August 24, 1935; allotype, female, Bronx, August 26, 1935; paratypes, two females, one from New York City, August 21, 1935, the other from Yonkers, New York, August 5, 1935, all collected by L. L. Pechuman.

Lauxaniidae

GRIPHONEURA SCHINER

Following is a key to the American species:

1.—Thorax rusty reddish yellow............................*ferruginea* Schiner.
   Thorax mostly blackish..2.
2.—Front coxae yellow..3.
   Coxae black or brown...4.
3.—Apex of the wing white, the apex of the fourth vein pale yellow; tibiae blackish ....*alboapicata* Malloch.
   Wings almost uniform in color or the veins faintly clouded with brown; legs reddish yellow, the femora somewhat darkened at the apex............... ....*tarsalis*, new species.

4.—Crossveins with brown clouds, the wing largely brown......*triangulata* Hendel.
Anterior crossvein never with brown cloud................................5.
5.—The brown wing cloud begins at or near the apex of the first vein and covers, in part, the whole apical half of the wing...........................6.
The brown cloud begins far beyond the apex of the first vein and does not extend basally to the middle of the wing............................7.
6.—Third antennal segment black, the brown of the wing extending back from the tip of the first vein to the posterior margin (*atricornis* Malloch, not Kertesz). ....*nigricornis*, new name.
Third antennal segment reddish; basal half of the wing pale except in front.. ....*suffusa* Malloch.
7.—Second to fourth veins pale yellow before the brown cloud; sicatrix of front tarsi not over two-thirds as long as the first segment....*imbuta* Wiedemann.
Second and third veins luteous or pale brownish; sicatrix on first segment of anterior tarsi occupying almost four-fifths of the segment...*affinis* Malloch.

Griphoneura tarsalis, new species

Blackish brown and reddish, with cinereous and brownish pollen; front tarsi white, the apical segments black and much broadened. Length, 6 mm.

MALE.—Head reddish, the face, cheeks and anterior border of the front yellowish. Front slightly longer than wide, the pollen brownish yellow, the sublateral vittae shining. Ocellars rather short. Occiput shining except below where it is whitish pollinose. Palpi reddish; proboscis reddish brown. Antennae orange, the arista black, moderately long plumose.

Thorax blackish brown, cinereous pollinose, the mesonotum mostly brown pollinose, pale in front and on the sides behind. Anterior border of the thorax, the posterior calli, metanotum and sternum reddish. Three dorsocentrals.

Legs reddish, the apical two tarsal segments black; the apical two segments of the front tarsi broadened and lengthened, the front tarsi white, the base reddish. Apices of the femora somewhat brownish.

Wings pale brownish luteous, the immediate base pale yellowish. Squamae yellowish, with brown fringe. Halteres yellow.

Abdomen blackish brown, with thin brown pollen. Sternites brownish red.

TYPES.—Holotype, male, and three paratypes, males, Barro Colorado, Canal Zone, December 22 and 29, 1938 (Curran).

Muscidae

Gymnodia scatophaga, new species

Differs from *normata* Bigot by having blackish-brown vittae on the mesonotum and only two antero-ventral bristles near the base of the posterior femora. In *normata* the mesonotal vittae are of a more reddish brown, the pollen more ochraceous between the vittae and in addition to the two strong ones there are two or three shorter bristles on the anteroventral surface of the posterior femora. The mesonotal vittae are much more sharply defined in *scatophaga*. Length, 5 mm.

MALE.—Face and front silvery white pollinose, the occiput cinereous; hair and bristles black. Front narrow above, the brown vitta obsolete for almost one-third its length; six pairs of short frontals limited to the anterior half of the front; ocellars long and strong; no verticals. Cheeks with strong brown tinge. Facial depression wide, the parafacials narrow and of a uniform width. Palpi dark reddish with the apical third black. Antennae brown; arista practically bare, thickened on the basal fourth. Eyes bare.

Thorax cinereous pollinose, with seven blackish-brown vittae; median vitta wide and entire, extending to the apical fourth of the scutellum; dorsocentral vittae extending from the front margin to the posterior dorsocentral bristle; the second pair of paired vittae extends back from the suture to the supra-alar bristle and is joined to the dorsocentral vittae along the suture; the sublateral vittae extend from the presutural bristle to the base of the wings. In addition to the mesonotal vittae there is a narrow brown stripe extending along the suture separating the mesonotum and pleura from the base of the wings to the humeri. Four postsutural dorsocentrals; sternopleurals 2–1.

Legs black, the tips of the femora and the bases of the tibiae more or less broadly reddish. Anterior tibiae without posterior bristle; posterior femora with only two anterodorsal bristles.

Wings cinereous hyaline; third vein without bristles; fourth vein scarcely curved forward.

Abdomen densely cinereous pollinose, the bristles arising from black or brown spots. Anterior border of the first segment broadly brown, this color produced broadly back on each side of a broad middle stripe of gray. On the second segment there is a pair of subtriangular brown spots which are somewhat variable in size and shape; they are in the form of broadly separated vittae with the posterior half expanded laterally. Third segment with a pair of broadly separated, large shining brown spots posteriorly and a pair of more approximated reddish-brown spots in front, these being obscurely connected with the shining spots; fourth segment with indications of a pair of reddish-brown vittae. The abdomen is mostly yellow on the basal half of the under surface, the pale color extending onto the dorsum on the base of the second segment and expanding to cover part of the first segment inside the dark sides. First sternite strongly haired.

FEMALE.—Pollen of face and front with ochreous tinge; brownish-yellow frontal triangle extending almost to the anterior edge of the front; brown markings on the second and following abdominal segments more extensive, more transverse on the posterior half of the segments, and there are brown marks on the sides of the third and fourth segments basally. There is little or no yellow ground color.

TYPES.—Holotype, male, allotype, female, and paratypes, three males and two females, Haiti, reared from cow dung (J. D. Myers). Type in British Museum of Natural History.

In Huckett's key to North American *Limnophora* Desvoidy this species will run out of the key to males of *Spilogona* Schnabl and Dziedzicki at couplet 51 on page 65, (Jour. N. Y. Ent. Soc., XL). Both *scatophaga*, n. sp., and *normata* Bigot differ from all other species placed in *Gymnodia* Desvoidy and *Spilogona* by the absence of hairs on the prosternum.

Metopiidae

Dexomyophora meyersi, new species

The male differs from *facialis* Townsend by the presence of long hairs on the posterior tibiae. In the female there is usually only one pair of postsutural dorsocentrals, the prescutellar pair absent or extremely weak. There is no small dorsocentral in front of the strong postsutural as described by Townsend. Length, 8.5 to 11 mm.

MALE.—Head golden yellow pollinose, the facial depression and the occiput, with the exception of the orbits, grayish. Front one-third as wide as one eye, the vittae blackish; nine to eleven pairs of frontals, the upper two or three reclinate, ocellars short and fine; outer verticals absent. Hair black, the occiput with white hair in the middle below the neck. Parafacials bare; facial cilia abundant, extending to the upper fourth of the ridges. Palpi and antennae brown, the latter with cinereous pollen, aristal rays long and numerous.

Mesonotum with yellowish or cinereous yellow pollen and three black vittae, the median one extending to beyond the middle of the scutellum, the basal corners of the scutellum also shining black. Pleura cinereous pollinose, the mesopleura yellowish. Acrosticals 0–1, although one or two pairs of presuturals are indicated; dorsocentrals 2–2 or rarely 2–1, the posterior pair absent; three pairs of marginal scutellars, the median pair weak, and one pair of discals; a pair of hairs between the apical scutellars. Three sternopleurals in an almost straight row; propleura with pile but there may be only one or two hairs; prosternum haired.

Legs black, the coxae and femora with cinereous pollen. Posterior tibiae villous postero-ventrally, many of the hairs uniting to form a fasciculate process; posterior trochanter with a dense group of very short hairs below.

Abdomen shining black in ground color, cinereous yellow or yellow pollinose, the fourth segment and sides more or less golden yellow; apices of the segments, a median vitta and expanded areas toward the sides without pollen; under surface with cinereous pollen; hair wholly black. First and second segments without median bristles, the third with one pair of marginals the fourth with a row. Genitalia brownish, cinereous or yellow pollinose. Posterior forceps short and broad, united for most of their length.

FEMALE.—Front two-thirds as wide as one eye, with one or two pairs of orbitals, the upper pair weak when present; facial cilia much longer than in the male; usually only one pair of postsutural dorsocentrals; tibiae and trochanters without unusual hair; ovipositor of simple type.

TYPES.—Holotype, male, allotype, female, and paratypes, five males and three females. Barabuirna, N. W. District, British Guiana, June, July, 1935 (J. G. Myers), reared from *Casnia licoides*. Type in British Museum of Natural History.

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A NEW GENUS OF BAT FROM COSTA RICA

By George G. Goodwin

Among the mammals in the U. S. National Museum collected in Costa Rica by the well-known field naturalist, Mr. C. F. Underwood, is a new genus of phylostomid bat allied to *Sturnira*. I wish to thank Mr. Gerrit S. Miller, Jr., and Major E. A. Goldman for the privilege of describing this new genus.

Subfamily **Sturnirinae**

STURNIROPS, NEW GENUS

Genotype.—*Sturnirops mordax*, new species.

General Characters.—Allied to *Sturnira* which it resembles in general appearance, but cranial characters distinctive.

Description.—Skull relatively long and narrow, with short rostrum and short toothrow as compared with the length of skull; canines large and massive; molars comparatively small; interorbital and post-palatal area elongated.

Dental Formula:

$$\frac{-23.1.--34567}{12-.1.-2-4567}\ \mathrm{i}\ \frac{2-2}{2-2},\ \mathrm{c}\ \frac{1-1}{1-1},\ \mathrm{pm}\ \frac{2-2}{2-2},\ \mathrm{m}\ \frac{3-3}{3-3} = 32$$

Sturnirops mordax, new species

Type.—No. 250310, U. S. National Museum (Biological Survey Collection); male adult; El Sauce Peralta, a farm on the Atlantic railroad, less than halfway from San Jose to Limon, probably about 1000 feet elevation; July 14, 1931; collector, C. F. Underwood. The type is a skin and skull in good condition. Only one specimen known—the type.

General Characters.—A medium-sized dark-colored bat, with normal noseleaf and rather short and pointed ears; no external tail; calcar small; interfemoral membrane reduced to a narrow, almost vestigual fringe densely furred; toes of hind feet sparsely covered with fine hairs; forearm furred at base for more than one-third its length. In general similar to *Sturnira lilium*, but slightly larger; canines larger and more massive; molars relatively smaller; toothrow short as compared with basal length of skull; incisors large; sides interorbital region nearly parallel, slightly converging anteriorly, least width at anterior margin of orbit.

Description.—General color light mummy brown, the hair dull brownish at base followed by a light dusky band and tipped with dark brown. Upper parts darkest on top of head and rump; under parts about like back; feet and membranes blackish.

SKULL.—Long and narrow; braincase moderately high; sagittal crest barely perceptible; rostrum about one-fourth greatest length of skull; least interorbital width at anterior margin of orbit; nares extended backward, with a squarish emargination about half as wide as nasal aperture; upper incisors completely filling space between incisors; inner incisors large, with crowns higher than long, slightly oblique, in contact near middle, the front surface convex, posterior surface concave, cutting edge with slight terminal emargination; outer incisors small, extending barely beyond cingulum of canine, about as long as high, the crown broadly concave in front, narrowly convex behind, cutting edge sharp, rising slightly to an angular point at middle; lower incisors small, closely crowded in a nearly straight line between canines, projecting forward and rising perpendicularly at a distinct angle with roots, crowns of inner pair with narrow backward extension, cutting edge with terminal emargination; canines strong, the upper more than half as long as high, the lower more slender with a narrow but distinct posterior heel; inner surface of upper canines strongly concave; premolars simple, rather low, edged with an outer cusp and inner concavity; upper molars quadrate in outline, slightly broader than long, the main portion of the teeth occupied by deep longitudinal groove extending without break from last molar to last premolar, a distinct protocone, paracone and metacone situated at extreme edges of crown; second molar smaller than first; third molar with less than one-third the crown area of second; lower molars similarly grooved to upper; second molar smaller than first; third lower molar about one-fourth of crown area of second; audital bullae small.

MEASUREMENTS OF TYPE SPECIMEN (skin measured in the field).—Head and body, 60 millimeters; hind foot (without claws), 14, in dry skin with claws, 16; ear, 18. Skull, greatest length, 24.6; condylobasal length, 22.5; greatest breadth, 12.25; least interorbital breadth, 5.2; greatest width outside upper molars, 7.7; palatilar length, 10; maxillary toothrow, 6.2; molariform series, 5.3; upper molar series, 3.2.

Sturnirops mordax is nearest to *Sturnira lilium*, but differs in the apparent absence of shoulder glands, relatively short toothrow, peculiar elongation of the interorbital area, and shortening of rostrum. It is very different from and needs no comparison with the little-known bat *Corvira*. The specific name *mordax* is used as descriptive of the enlarged anterior teeth.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXVII[1]

ON PAN-ANTARCTIC TERNS

By Robert Cushman Murphy

In the course of identification of terns collected during the Whitney South Sea Expedition at islands near New Zealand, it became apparent that a revision of all the Pan-Antarctic representatives was desirable. This seemed the more urgent because some of the conclusions drawn in the discussion of several forms in my 'Oceanic Birds of South America' (1936: pp. 1099–1114) have proved untenable.

The present study has been facilitated by an opportunity to examine most of the important specimens belonging to European collections, and by the recent publication of Falla's masterful volume on the birds of the B. A. N. Z. Antarctic Research Expedition of 1929–1931 (1937).

THE PAN-ANTARCTIC ZONE

The Pan-Antarctic marine zone may be defined as the area lying between the Sub-Tropical Convergence and the shores of the Antarctic Continent. There are, however, two distinct geographic usages in the classification of the southern circumpolar areas. That developed by the oceanographers of the Discovery Committee of the British Colonial Office (Deacon, 1937: Fig. 4) is the one followed in 'Oceanic Birds of South America.' The usage adopted among German oceanographers differs from this (Schott, 1935: p. 163) in that the Antarctic Zone comprises two subdivisions, a Sub-Antarctic and an Antarctic, while the Sub-Antarctic Zone of the British school is designated the Zone of Mixed Waters. Both systems agree in the designation and position of the Sub-Tropical Zone, but the slightly different course that each assigns to the Sub-Tropical Convergence, as represented in recent publications by Hart and Schott, respectively, has an important bearing upon the present problem.

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[1] Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, and 947.

At any rate, the Pan-Antarctic represents the Antarctic and Sub-Antarctic belts of the British system, and the Antarctic and Zone of Mixed Waters of the German system. The terns falling within this field include one species (*Sterna paradisaea*) which is a seasonal migrant from the northern hemisphere to the southern oceans; another (*Sterna virgata*) which is endemic at certain islands lying on or near the Antarctic Convergence; and a third (*Sterna vittata*) which is of wide distribution throughout the Pan-Antarctic Zone. The last species breaks up into several local subspecies, one of which extends its breeding range north of the position assigned by the 'Discovery' authors to the Sub-Antarctic Convergence, or as far as islands which they would relegate to high latitudes of the Sub-Tropical Zone, namely, St. Paul and Amsterdam, in the southern Indian Ocean.

THE ZONAL STATUS OF ST. PAUL AND AMSTERDAM ISLANDS

Hart (1937: Figs. 2–4) shows the probable average positions of the Sub-Tropical and Antarctic Convergences in south polar projection, as they have been deduced from the 'Discovery' investigations. In this plotting, St. Paul and Amsterdam lie to northward of the Sub-Tropical Convergence. Schott (1936: Pl. XXIV), however, lays the course of this convergence across the southern Indian Ocean on a trend which brings St. Paul and Amsterdam just south of it. The latter relationship is in harmony with the biotic observations of Vélain (1877). Giant kelp (*Macrocystis pyrifera*) is even more luxuriant at these islands than at Tristan da Cunha. Hart (p. 417) reports that the 'Valdivia' Expedition obtained a typically sub-antarctic "indicator" diatom at St. Paul Island. Zonal birds common to St. Paul, Amsterdam, Gough, and Tristan include a penguin (*Eudyptes crestatus*), two albatrosses (*Phoebetria fusca* and *Diomedea chlororhynchos*), the broad-billed whale-bird (*Pachyptila forsteri*), and a form of one of the terns discussed in this paper (*Sterna vittata*).

The conclusion would seem to be that St. Paul and Amsterdam are categorically sub-antarctic rather than sub-tropical. Their biogeographic affinities are clearly with Tristan da Cunha rather than with the much less distant island of Kerguelen, a fact revealed in the vegetation no less than in the native animal life. That there should still be differences of opinion regarding the zonal status of St. Paul and Amsterdam only emphasizes a fact pointed out by James (1936: p. 667), namely, that the failure of the strictly hydrologic divisions of the world ocean to coincide fully with biologic, climatic, or other natural regions offers a fruitful field for analytic investigation.

SPECIMENS OF PAN-ANTARCTIC TERNS EXAMINED

The generous coöperation of my colleagues in many other institutions has enabled me to bring together much important, and some historic, material for direct comparison. Dr. Erwin Stresemann, in particular, has not hesitated even to send pertinent type specimens from Berlin to New York. The Rothschild Collection, now part of that of The American Museum of Natural History, has also been of particular aid. All of the pan-antarctic terns studied are listed below, with credit to the sources. The adopted nomenclature is explained in the subsequent systematic section.

Sterna virgata	
Amer. Mus. Nat. Hist.	1, Kerguelen Island
U. S. Nat. Mus.	4, " "
Zoöl. Mus. Berlin	6, " "
British Mus.	6, " "
Sterna paradisaea	
Royal Scottish Nat. Hist. Mus.	1, 64° 38′ S., 35° 13′ W.
	1, 68° 32′ S., 12° 49′ W.
British Mus.	2, 66° S., 157° W.
Zoöl- Mus. Berlin	1, 56° S., 66° E.
	4, 66° S., 91° E.

The last four specimens are the type and cotypes of the "*Sterna macrura antistropha*" of Reichenow.

Sterna vittata vittata	
Amer. Mus. Nat. Hist.	1, Kerguelen Island
British Mus.	1, " "
Sterna vittata tristanensis	
British Mus.	3, St. Paul Island
	2, 36° 56′ S., 35° E.
	1, Gough Island
	2, Tristan da Cunha
	1, 35° S., 0° 30′ E.
Sterna vittata bethunei	
Amer. Mus. Nat. Hist.	5, Antipodes Islands
	2, Bounty Islands
	2, Campbell Island
	1, Chatham Islands (?)
	3, Snares Islets
Mus. Comp. Zoöl.	1, " "

Sterna vittata georgiae	
Amer. Mus. Nat. Hist.	18, South Georgia
Zoöl. Mus. Berlin	22, " "
Sterna vittata gaini	
Amer. Mus. Nat. Hist.	4, South Shetland Islands
Sterna vittata macquariensis	
Described by Falla, August, 1937	
No specimens seen	

The above naturally include a proportion of ancient, sadly battered specimens, accompanied by more or less deficient data. Nevertheless, practically all of them are useful, and a number are of critical taxonomic interest. More serious as a bar to final conclusions than the condition of any of these 95 specimens is the fact that I have seen no terns whatsoever from the following pan-antarctic islands: South Orkneys, South Sandwich group, Bouvet, Prince Edward and Crozet groups, Heard, and Macquarie. Fortunately, Mr. Falla's publication has now supplied useful data on the resident terns of several of these localities.

THE ARCTIC TERN AND THE ANTARCTIC TERN

Of greatest general interest among the questions discussed in this paper, is the zoögeographic problem which concerns the range relationships of the two species of terns (*Sterna paradisaea* and *S. vittata*) known, respectively, by the vernacular names of the above heading. The subject has been discussed in 'Oceanic Birds of South America,' particularly on pp. 1102, 1103, 1107, and 1108, but the conclusions arrived at by both Gain (quoted on p. 1107) and myself have proved to be in part incorrect. A rectification is therefore of first importance.

I have now had the privilege of examining nine specimens of arctic terns collected between latitudes 56° and 68° S. The longitudes of the collecting stations fall, as noted in the foregoing list, within each of the four south polar quadrants, namely, the American, Indian, Australian, and Pacific. Further evidence would scarcely be required to show that the arctic tern does regularly migrate as far as the pack-ice belt of the southern oceans, and even across the Antarctic Circle.

In any event, the publication of Falla's paper has removed all doubt. Reporting upon the birds of Sir Douglas Mawson's British, Australian, and New Zealand Antarctic Research Expedition (1929–1931), of which he was a member, and upon those of the Australasian Antarctic Expedition (1911–1914), Falla (1937: pp. 251–254) writes that ten moulting adult arctic terns were collected in antarctic seas (beyond latitude 64° S., and between longitudes 84° and 118° E.) during the months of

January and February, 1931. Furthermore, birds of this species were encountered in large numbers in the pack ice to southward of latitude 54° S., and as far as longitude 150° E., throughout the antarctic summer period or from December to March.

Owing to the presence of a resident antarctic tern in sections of the same waters, particularly in those close to certain parts of the south polar continental shore, the need for caution, to which I have formerly called attention, still holds. We have no means of judging the reliability of sight records of arctic terns in the Far South unless they are correlated with the collection of specimens.

THE SPECIES AND RACES OF PAN-ANTARCTIC TERNS

Sterna virgata

Sterna virgata Cabanis, 1875, Journ. fur. Ornith., XXIII, p. 449 (Kerguelen Island); Falla, 1937, p. 255.

This tern, which is confined to islands and waters close to the Antarctic Convergence, is a strongly marked species, differing from *vittata* and the other terns of this paper in several or all of the following respects: mantle dark smoky gray, with the ventral surface scarcely lighter, so that the white moustachial streak stands in strong contrast with the gray chin and throat; wing lining distinctly gray instead of white; gray band occupying two-thirds of the breadth of the inner web on the outermost primary; outer webs of the tail streamers strongly gray, the other rectrices grayish rather than white; bill decidedly short, averaging somewhat less than in the smallest subspecies of *S. vittata*. Falla's excellent notes make further description unnecessary.

No taxonomic question is raised by this species because I have seen examples only from Kerguelen Island. The total extent of the breeding range of *virgata* is still problematical, and it seems to have grown "on paper" rather than through determination by field collecting. Saunders (1896: p. 50) lists 12 British Museum specimens from Kerguelen and one from the Crozets. The latter specimen does not appear among those sent to me from the British Museum, but Falla lists the species on "sight record" from the Crozets. Terns known to the old-time sealers as "king birds" are abundant at both the Crozet and Prince Edward groups, but specimens appear to be practically non-existent.

Saunders adds that the range of *virgata* includes "probably Heard Island." In later literature the tendency has been to drop the word "probably" and to extend the range still farther, but neither in Reichenow (1908: p. 562), Peters (1934: p. 334), nor Falla do I find anything definitely to substantiate a Heard Island record. The question is important because Heard belongs to the deep antarctic belt. The distribution of *Sterna virgata* evidently needs further investigation. Apparently the species has never been taken at sea far from land, and it may prove to be a highly sedentary bird, peculiar to one or more groups of intermediate antarctic islands in the Indian quadrant.

At Kerguelen Island the ranges of *virgata* and *vittata* overlap. Falla has written, however, about an extraordinarily significant ecological difference between these two terns, which he discovered during the recent polar cruise. At Kerguelen *virgata* lays its two eggs during October and November, only to be replaced on the same nesting areas in January and February by *vittata,* which lays but a single egg. Thus interspecific competition is avoided during the nesting period. A further parting of the ways results from the fact that *virgata* is more or less of a land-feeder, capturing spiders, insects, etc., in the marshes of the inland hills, while *vittata* is exclusively marine. Such functional differences, discoverable not from specimens but only through painstaking field work, exemplify the light that remains to be thrown upon the interrelationships of pan-antarctic birds.

Among the 17 specimens I have examined, only three adults have sufficient data to permit comparison as to the relative size of the sexes.

2 males: wing, 260–265 (262.5); tail, 123.5; exposed culmen, 29.2–30.6 (29.9); tarsus, 17.8–18.9 (18.3); middle toe and claw, 24 mm.

1 female: wing, 253; tail, 129.1; exposed culmen, 29 mm.; (legs missing).

Sterna paradisaea

Sterna paradisaea PONTOPPIDAN, 1763, 'Danske Atlas,' I, p. 622 (Denmark); MURPHY, 1936, p. 1099.

Sterna macrura antistropha REICHENOW, 1904, Orn. Monatsb., XII, p. 47; 1904, Sitzungsb. Ges. naturf. Freunde, Berlin, XII, p. 172.

Sterna macrura, FALLA, 1937, p. 251.

As regards *S. paradisaea* and *S. vittata*—the arctic and antarctic terns—the remarkably close resemblance between adult stages of the two has often been pointed out. However, since *vittata* is represented in pan-antarctic waters by several subspecies of differing shades, sizes, and proportions, it is important to stress only the characters which invariably distinguish the two species as a whole. These are reduced to very few as follows:

The tarsus in *S. paradisaea* is relatively much shorter than in any form of *vittata*, and absolutely shorter than in the smallest race of *vittata.*

The plumage of *paradisaea* is of a lighter and more pearly gray, particularly on the ventral surface, than that of the palest race of *vittata*. The gray band next the shaft on the inner web of the outer primary is decidedly narrower in *paradisaea* than in the race of *vittata* which most closely approaches *paradisaea* in this respect. The outer webs of the lateral rectrices in *paradisaea* are dark gray, sharply contrasting with the white inner webs, a condition not quite duplicated in any form of *vittata*. Furthermore, the tail streamers are relatively longer and more slender in *paradisaea* than in any form of *vittata*.

In condition of plumage and in dimensions affected thereby, the nine examples I have examined of arctic terns from pan-antarctic waters, all of which were collected during the southern-hemisphere summer season, agree closely with migrant specimens from both coasts of South America. When compared with birds from northern-hemisphere breeding grounds, the antarctic examples naturally show prevailingly much shorter wings and tails. Falla's life-history observations fully explain this difference.

As noted heretofore, Falla found arctic terns abundant in the pack ice between Ross Sea and Enderby Land. The birds were in heavy moult; during December and January they perched on lumps of ice most of the time and flew unsteadily when driven up by gales and ice-movements (information *in litteris*). Such observations fully explain the comments by Vanhöffen and other German authors quoted in 'Oceanic Birds of South America.' The condition of specimens examined by Falla indicated that the moult would be completed, and breeding plumage assumed, toward the end of March.

The richer hue of bill and feet, emphasized by Reichenow when he described the antarctic birds as a new race (and subsequently as a new species), is regarded by Falla as due to a temporary excess of pigment in the antarctic moulting birds. He writes: "In our specimens rich liquid pigment could be pressed out from beneath the thin plates of the bill." A subsequent remark to the effect that the stomachs of the terns shot were filled with a red crustacean (*Euphausia*) may have causative significance in relation to the brilliantly colored bills and feet. Quite possibly the arctic terns find a richer source of red pigment in the principal pelagic food of their antarctic range than in any organism of the northern-hemisphere breeding range. One or more such pigments are known to withstand metabolic processes and to be redeposited in the tissues of the eater.

The nine antarctic specimens of the arctic tern that I have examined include no less than three—two males and one female—labelled as the type of Reichenow's *antistropha!* One of the males is the specimen figured in color (1908: p. 463). Their dimensions are as follows:

4 males: wing, 257–265 (261); tail, 145.5; exposed culmen, 30.9–35.1 (32.5); tarsus, 15–16.4 (15.8); middle toe and claw, 21.7–23.2 (22.3) mm.

5 females: wing, 246–265 (258); tail, 129–165 (147.5); exposed culmen, 27.7–31 (29.5); tarsus, 15.4–17.3 (16); middle toe and claw, 19.1–24.2 (21.5) mm.

Sterna vittata vittata

Sterna vittata GMELIN, 1789, 'Syst. Nat.,' I, pt. 2, p. 609 ("Insula Nativitatis Christi" = Christmas Harbor, Kerguelen Island).

Sterna vittata vittata, FALLA, 1937, p. 258.

Kerguelen Island is the type locality of the species. The resident form is a race of intermediate size and relatively dark coloration. I have seen no examples from the nearest islands to westward and southward at which it has been alleged also to reside. Falla believes that he observed a form of this species at Heard Island but, unfortunately, none was collected there.

I have examined but two specimens, in which the breeding plumage may be described as follows:

Pileum and nape black; a white line, narrow above the commissure of the bill, broadening from the lower eyelid ventrad across the cheek, and outlining the black cap except at its caudad extremity; wing lining and tail, including the coverts of the latter, white, the outer webs of the rectrices washed with faint gray; remainder of body plumage close to the deep gull gray of Ridgway, and scarcely lighter on the ventral than on the dorsal surface; primaries with a silvered gloss of gray darker than that of the mantle, the outer web of the outermost blackish; shaft of the outermost primary clear white, those of the others slightly dulled or grayed; outermost primary with a deep neutral gray band, of some 4–5 mm. in width, on the inner web next the shaft, the corresponding bands broadening and extending on succeeding primaries which, in the same order, bear decreasing tongues of white on their inner webs; inner webs of proximal remiges mostly white, the secondaries also tipped and externally fringed with white, forming a single wing band. Bill, legs, and feet red, the bill in life being usually described as "coral," the feet as "blood" or "arterial" red.

Because of the grayness of Kerguelen birds, and also on general zoögeographic grounds, it is a mistake to assume that the typical subspecies of this tern inhabits such diverse breeding localities as Kerguelen, Heard, St. Paul, Amsterdam, and the islands of Tristan da Cunha. As a matter of fact, two adult females taken in mid-January in latitude 36° 56′ S., longitude 35° E. (southeast of the Cape of Good Hope), are considerably lighter in shade than the Kerguelen examples, and I have, after due comparison, referred them to another race. Furthermore, it should be noted that the species *vittata* has not yet been certainly recorded from such islands as the Crozets, Prince Edwards, and Bouvet

Falla has made the very interesting discovery that at Kerguelen this tern occupies the territory of *Sterna virgata* after the latter species has finished its breeding season. Corresponding stages in the life histories of the two species are, on the average, about two months apart.

A specimen of known sex measures as follows:

1 male from Kerguelen Island: wing, 265; tail, 137.7; exposed culmen, 34.2; tarsus, 17.3; middle toe and claw, 23.1 mm.

Sterna vittata tristanensis, new subspecies

Sterna melanorhyncha GOULD, 1865, 'Handb. Birds Australia,' II, p. 399 (*partim*, for egg from St. Paul Island).

Sterna sancti-pauli GOULD, 1865, *ibid.* (synonym for *S. melanorhyncha* = *S. striata*).

Sterna vittata, subspecies, MURPHY, 1936, p. 1113.

SUBSPECIFIC CHARACTERS.—Larger than typical *vittata*, and with longer tail streamers than any other race. Plumage of a lighter shade of gray throughout than in the typical race.

TYPE.—British Museum Register, 1906. 12. 21–20; ♂ ad.; Tristan da Cunha Island; January 17, 1906; Michael J. Nicoll.

RANGE.—Known from the islands of the Tristan da Cunha group and Gough Island, in the Atlantic, from St. Paul Island in the Indian Ocean, and from pelagic localities off South Africa.

The nine specimens I have examined from Tristan, Gough, St. Paul, and intervening oceanic areas all seem to represent one race, paler and larger than the birds of Kerguelen. It is the largest of all the races of *vittata*, in fact, except the form of West Antarctica (*gaini*). The outer rectrices are longer and narrower than in typical *vittata*, and the gray band next the shaft on the inner webs of the primaries is likewise narrower. The difference in the shade of gray characteristic of Kerguelen and Tristan specimens, respectively, cannot be expressed exactly by any terms with which I am acquainted. It approximates or approaches, however, the difference between "deep gull gray" and "gull gray" (samples 7 and 8 in the carbon gray series of Plate LIII, Ridgway, 1912).

It is very interesting that a uniform sub-antarctic environment encompassing, between Tristan and St. Paul, a quarter of the circumference of the world along the fortieth parallel of latitude, should be inhabited by a common subspecies and that the latter should prove to be distinct from the tern confined to one or more islands near the fiftieth parallel. The distribution is thus in harmony with that of albatrosses, plants, and other organisms.

The type of this race was collected during the cruise of the Earl of Crawford's yacht 'Valhalla.' Other Tristan and Gough Island specimens in beautiful plumage were obtained by Wilkins on the return from the Antarctic of the 'Quest.' The localities of all the examples I have seen are listed on page 3. The alleged presence of this tern at St. Helena and Ascension has been shown to be erroneous (Murphy, 1936: pp. 109, 154, 1106), though it has been collected in various parts of the South Atlantic, particularly to westward of the Cape of Good Hope but also between St. Helena and Ascension and perhaps near the coast of southern Brazil.

This race has been the subject of a curious nomenclatural tangle. In 1865, Gould, regarding the specific name of *Sterna melanorhyncha* as "inappropriate," proposed the new name *sancti-pauli* for the Tasmanian tern now known as *S. striata.* A confusion of the Tasmanian species with a tern's egg from St. Paul Island caused his choice of the new name. My colleague, Mr. John T. Zimmer, informs me that under such circumstances *sancti-pauli* becomes solely a synonym of *striata* and that the tern of St. Paul, which is of another species and an undescribed subspecies, requires a new name.

6 males from Tristan da Cunha, Gough, and St. Paul islands and from latitude 35° S., longitude 0° 30′ E.: wing, 252–260 (254.7); tail, 163.3–183 (173.3); exposed culmen, 36.3–37.7 (37.1); tarsus, 19.5–19.8 (19.7); middle toe and claw, 26.3–27 (26.6) mm.

3 females from Tristan da Cunha and from latitude 36° 56′ S., longitude 35° E.: wing, 260–267 (263.3); tail, 161–179.2 (168.8); exposed culmen, 34.6–36.2 (35.5); tarsus, 18.4–20 (19.2); middle toe and claw, 25.9–27.1 (26.5) mm.

Sterna vittata macquariensis

Sterna vittata macquariensis FALLA, 1937, 'B. A. N. Z. Antarctic Research Exp. 1929–1931, Reports'—Series B, II, p. 260 (Macquarie Island).

Falla has published the first useful systematic notes on the resident tern of Macquarie Island, of which 17 skins were collected in 1912 and 1913 during the Australasian Antarctic Expedition.

I have seen no specimens. The stated diagnostic characters of the subspecies are not sufficient, in the absence of an opportunity for comparison, to separate this race with certainty from the one inhabiting islands closer to New Zealand, to which a name has already been given.

The extreme and average dimensions among nine males and eight females measured by Falla are as follows:

Wing, 226–278 (257.6); tail, 102–150 (126.3); exposed culmen, 31–37 (33.9); tarsus, 16.5–18 (17.5); middle toe and claw, 22–25 (23.6) mm.

Sterna vittata bethunei

Sterna bethunei "Travers" Buller, 1896, Trans. and Proc. New Zealand Inst., XXVIII (1895), p. 348 (Bounty Islands).

Sterna vittata bollonsi Mathews and Iredale, 1913, Ibis, p. 244 (Sub-Antarctic Islands of New Zealand).

So far as can be judged from the material, a single form of *S. vittata* inhabits all the sub-antarctic islands close to New Zealand. In addition to five Whitney Expedition birds, I have seen nine others, the source of the 14 adults being as follows:

Bounty Islands, 2 (February); Antipodes Islands, 5 (February); Campbell Island, 2 (June); the Snares, 4; Chatham Islands, 1. The last, if correct as to source, would represent a new record, but since it is a bird in the Rothschild Collection without other data than the alleged locality, it would be well not to place too much credence in it.

The subspecies is light in hue, generally resembling *tristanensis*, but the tail is markedly and consistently shorter and the feet apparently smaller than in the latter race. The New Zealand area is isolated rather by pelagic space than by zonal barriers from the islands of the Indian quadrant, and the extent of the distinction between the terns of St. Paul and those of Bounty Island deserves further study. The additional task of an adequate comparison of *bethunei* and *macquariensis* may prove practicable for New Zealand ornithologists.

Mathews and Iredale have applied a new name (*bollonsi*) to this tern on the ground that Buller's name (proposed in manuscript by Travers) is a *nomen nudum.* This is not quite correct, however. Even though Buller considered the Bounty Island bird to be identical with the form inhabiting Kerguelen, he presents at least a brief characterization and associates the type specimen with a definite locality. Many accepted technical names derive from less practical original descriptions than this.

Mathews and Iredale state that examples of the race differ from topotypical birds in their lighter coloration above and below, and probably in a shorter wing measurement. The distinction in shade is undeniable but, like that of wing-length, it holds also for the race described from Macquarie.

6 males from the Antipodes and Snares islands: wing, 250–259 (256.5); tail, 124.6–138 (130); exposed culmen, 35.1–37.5 (36.5); tarsus, 18–19.5 (18.8); middle toe and claw, 23.5–25.5 (24.3) mm.

3 females from the Antipodes and Snares islands: wing, 250–270 (260); tail, 119–136 (127.5); exposed culmen, 32.3–38.4 (36.2); tarsus, 18.4–19.5 (19); middle toe and claw, 23.7–24.6 (24.3) mm.

Sterna vittata georgiae

Sterna vittata georgiae REICHENOW, 1904, Orn. Monatsb., XII, p. 47 (South Georgia); MURPHY, 1936, p. 1109.

The addition of the Berlin examples of the South Georgian tern to the fine series in the American Museum Collection has given me a satisfactory total of 35 specimens of this form to use as a basis for my studies. Measurements of 26 adults show that this is the smallest race within the species, the lesser size being especially notable in the length of bill and tarsus. It is a long-winged form, despite its diminutive size, but its bill, legs, and feet are relatively as well as absolutely small, and the streamers of the outer rectrices never show a development comparable with that in the neighboring sub-antarctic race (*tristanensis*). Furthermore, the measurements indicate that sexual dimorphism among terns of this group is very slight, being detectable, indeed, only in the bill. The average length of the culmen among females of the South Georgian race is less than 2 mm. shorter than among males.

The fact that the smallest form of *vittata* inhabits South Georgia, whereas by far the largest form (*gaini*) occurs in the not distant South Shetland Islands and those of the West Antarctic chain, suggests how unjustifiedly the subspecific name *georgiae* has been applied to the breeding tern of the South Orkney Islands (Peters, 1934: p. 333; Ardley, 1936: p. 373). I have seen no specimens from the latter archipelago and hence can throw no new light upon the subject, but it is certain that no critical data have yet been published which would justify the identity of the South Orkney resident tern to a subspecific degree. For the present, *georgiae* should be considered as endemic at South Georgia and the South Orkney tern as of an unknown race.

18 males: wing, 246–270 (257.6); tail, 123.4–137.5 (129.2); exposed culmen, 30–32.8 (31.2); tarsus, 16–17.8 (16.7); middle toe and claw, 20.1–22.5 (21.6) mm.

8 females: wing, 255–266 (262.3); tail, 121.2–134.7 (131.2); exposed culmen, 28.5–30.5 (29.4); tarsus, 15.9–17.5 (16.5); middle toe and claw, 21.2–23.9 (21.9) mm.

Sterna vittata gaini, new subspecies

Sterna vittata, subspecies, Murphy, 1936, pp. 1105–1109 (West Antarctic Archipelago).

Subspecific Characters.—Most closely resembling the subspecies *georgiae* but of comparatively huge size. In wing-length and bulk of body it is the largest representative of the species, but its bill, legs, and feet are relatively small, as in the South Georgian form.

Type.—Amer. Mus. Nat. Hist. 196219; ♂ ad.; Deception Island, South Shetlands; December 1, 1921; A. G. Bennett.

Range.—Specimens seen only from Deception Island, but the bird is recorded by Gain (1914: p. 89) from several other localities in the West Antarctic Archipelago, in which part of the world it has frequently though erroneously been reported upon under the name of *Sterna hirundinacea*, an exclusively South American species (Murphy, 1936: pp. 1095, 1105).

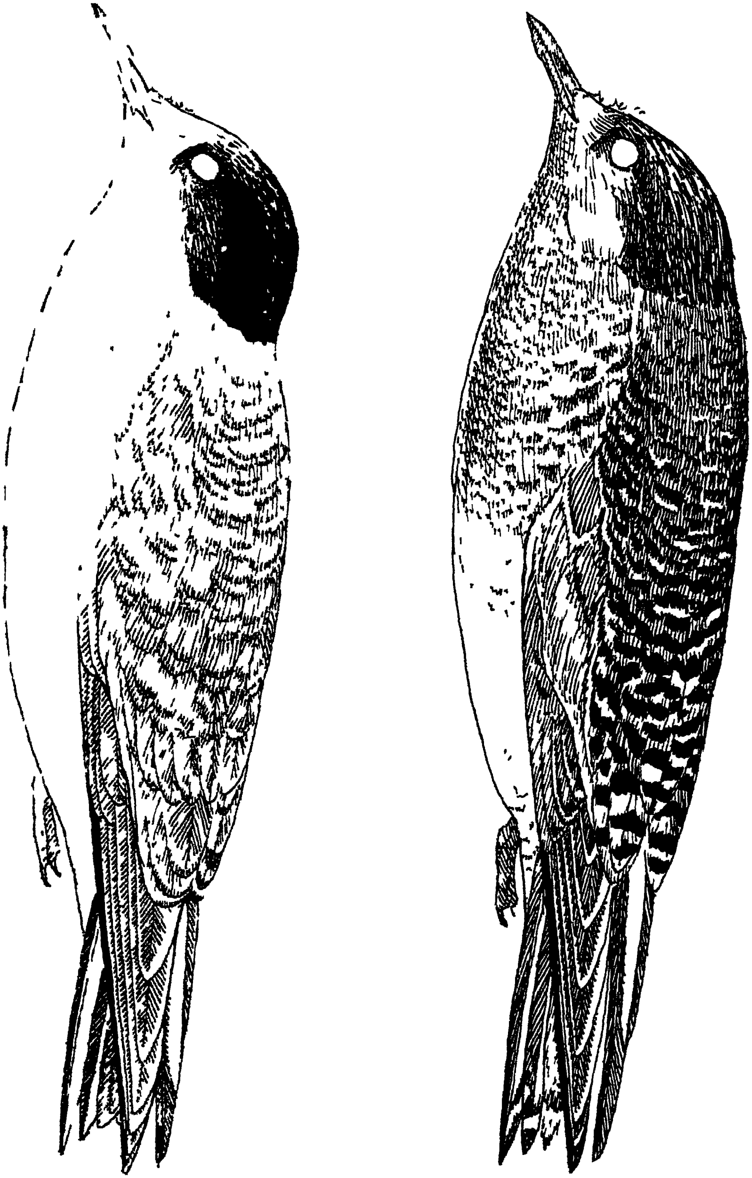
All available information about the form of *vittata* inhabiting the islands of West Antarctica has been summarized in 'Oceanic Birds of South America.' I take pleasure in naming this exceptionally well-marked subspecies in honor of Dr. Louis Gain, whose report on the birds of the Second French Antarctic Expedition, 1908–1910, is a monument in the annals of south polar zoölogy.

4 males from Deception Island: wing, 277–284 (281.5); tail, 146–156.7 (150); exposed culmen, 34.7–37.1 (36.2); tarsus, 18.3–18.8 (18.6); middle toe and claw, 23.2–24.6 (24) mm.

AFFINITIES SUGGESTED BY IMMATURE BIRDS

It is almost too facile to point out putative relationships between northern- and southern-hemisphere terns by means of comparing adults in breeding plumage. Thus *S. paradisaea* and certain races of *S. vittata* resemble each other about as closely as two distinct species well might. The similarity between the northern *S. hirundo* and the southern *S. hirundinacea* is somewhat less marked, but has been referred to by Saunders (1896: p. 53) and others. Such resemblances have led, indeed, to the not unnatural but entirely speculative assumption that the antarctic tern (*vittata*) first arose as a result of the establishment of southern-hemisphere breeding stations by transient arctic terns.

It appears, however, that in such a uniform and cosmopolitan group as the black-capped terns too much reliance may not be placed in adult resemblances as a criterion of close blood relationship. When young birds are compared, resemblances appear in new combinations, and a line of cleavage seems to separate the terns of the southern hemisphere from those of the northern hemisphere. The arctic tern, even in its



EQUIVALENT YOUTHFUL STAGES OF THE ARCTIC AND THE ANTARCTIC TERNS

Left: *Sterna paradisaea*, ♂, L. C. Sanford Collection, Amer. Mus., 3691, Pilgrim River, Alaska, July 27, 1911, R. H. Beck.

Right: *Sterna vittata georgiae*, ♂, Amer. Mus. Nat. Hist., 132549, South Georgia Island, January 11, 1913, R. C. Murphy.

most heavily marked youthful stage, does not closely approach the very dark, transversely barred dorsal plumage of *S. vittata*, nor does it ever exhibit the buffy and gray speckling which covers the throat and upper breast in the juvenal stage of the latter species.

On the other hand, the dark down and dark juvenal plumage of *vittata* is of a type which is the rule among a whole group of southern-hemisphere terns. Thus the juvenal plumage in *hirundinacea*, *vittata*, and *virgata* has a surprisingly common aspect, young of the two former being almost exactly alike except as to size. Still a fourth southern species, *S. striata* of New Zealand, has a similar heavily barred and streaked buff-and-blackish dorsal surface when young, although its ventral plumage lacks the speckling which is so conspicuous in the other three.

It is not only curious, but is also a warning against jumping at conclusions, that the characteristics of youthful terns should be thus correlated with breeding ranges in one hemisphere, rather than with resemblances and apparent relationships of adults from nesting grounds on opposite sides of the equator.

Among all forms of *Sterna vittata* and the two other species of terns treated in this paper a slight discrepancy in size appears to be correlated with sex, males being on the average a little larger than females, at least in the length and diameter of the bill. Since, however, the labels of so many of the 95 specimens listed on pages 3 and 4 lack sex determination, I have disregarded this item in preparing the accompanying table of comparative measurements of adult terns.

AVERAGE DIMENSIONS, ADULTS OF BOTH SEXES, PAN-ANTARCTIC TERNS

	WING	TAIL	CULMEN	BILL FROM NOSTRIL	MANDIBULAR GONYS	DEPTH OF BILL AT BASE OF CULMEN	TARSUS	MIDDLE TOE AND CLAW
Sterna virgata								
14, Kerguelen Island	257	129	28.1	18.1	13.5	7.9	18.1	23.3 mm.
Sterna paradisaea								
8, circumpolar pan-antarctic seas	259	147	31	23.3	18.2	7.7	15.9	22
17, Atlantic and Pacific coasts of South America	254.5	143.6	30.9				15.6	22.3
Sterna vittata vittata								
2, Kerguelen Island	267	139.5	33	22.5	16.7	9	18	23.5
Sterna vittata tristanensis								
9, St. Paul, Gough, Tristan da Cunha, and oceanic	258	172	36.5	26.4	20.4	9.1	19.5	26.6
Sterna vittata bethunei								
14, Antipodes, Bounty, Campbell, Snares islands	258	134	36.4	25.8	19.3	9.2	18.9	24.3
Sterna vittata georgiae								
26, South Georgia	259	130.5	30.6	20.8	16.2	7.6	16.7	21.8
Sterna vittata gaini								
4, Deception Island, South Shetlands	281.5	150	36.2	25.7	19	9.3	18.6	24

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OSTEOGRAPHY OF THE EAR REGION IN MONOTREMES

BY GEORGE GAYLORD SIMPSON

The ear region in monotremes is decidedly different from that in any other animal, and in some respects it seems to retain reptilian peculiarities otherwise unknown among recent mammals. For both these reasons it has been studied long and often and already has an extensive literature. Most of these publications have a special point of view, considering the ear region embryologically, or cursorily in a review of the whole skull, or incidental to a special consideration of one part, such as the tympanic. Among these many studies, however, there seems to be none that gives adequate descriptions and figures from the point of view most desirable to the comparative osteologist, or to the paleontologist in that capacity. This inadequacy of available data, which certainly is not confined to monotremes since clear and complete osteographic descriptions of the whole ear region of any animal are extremely few, was particularly felt in the course of a recent attempt to interpret the ear region in a multituberculate. This necessitated a rather detailed study of what should strictly be called the osteography of the ear region in monotremes, and the result is here presented. The aim is to illustrate and to identify all the essential structures of the bones surrounding and enclosing the auditory apparatus, as they are seen in macerated skulls of adult monotremes. The tympanic and the auditory ossicles are not discussed, nor are sutures and questions of bone homologies.

Most of these structures have been at least mentioned by one author or another, and the task is thus one of combining and illustrating their results, deciding between conflicting observations, and adding the points that seem to have been omitted. The most important previous work touching the particular subject of this paper is that of Eschweiler, Denker, Van Bemmelen, Van Kampen, Alexander, Gaupp, and Watson (see references). All these authorities have been consulted for data here assembled, but it may be noted that Gaupp's study was found the clearest, most accurate, and most nearly complete from the present point of view. There are a few other contributions, most of them cited by the authors already mentioned, but in general they are of less value for the particular subject of this study, and one or two are merely curiosities.

The material for this study is in the Department of Comparative Anatomy of this Museum and was kindly placed at my disposal by Dr. W. K. Gregory. The illustrations were drawn by John C. Germann.

TACHYGLOSSUS

The Tachyglossidae (or "Echidnidae"[1]) are here represented by specimens of *Tachyglossus aculeatus*, the common (or only) living Australian species of the family.

The outer ear in monotremes has no appreciable effect on the hard parts. There is no bony meatus or even an auditory notch or groove, and the tympanic is free of the cranium and not supported on definite pedicles. The middle ear is widely open below (here and throughout, only the bony structure of a macerated skull is in question) but in *Tachyglossus* is sharply bounded by an elevated and in places underhanging rim. The tympanic cavity as a whole is large and irregularly triangular. The posterior border is almost transverse, only a little more posterior at the external corner, and is formed by ossification of the pars cochlearis capsulae auditivae overlaid by cancellous bone (Gaupp).[2] The inner border of the tympanic cavity is approximately anteroposterior, with the anterior end more external, and is strongly underhung by the so-called echidna pterygoid or epipterygoid (Watson). The third, anteroexternal, border is markedly oblique, anterointernal-posteroexternal, and in its anterior part is defined by a sharp but only slightly underhanging crest against the glenoid surface. The posterior part is complex as will appear below.

A low, well-defined anteroexternal-posterointernal crest immediately anterointernal to the fenestra vestibuli, identified by Gaupp as a crista infrafacialis, divides the roof of the cavity into a large main portion, the fossa tympanica (*sensu stricto*), and a smaller, more complex external and posteroexternal part. The main fossa is simple and in general faces ventrally and slightly externally. The more external part is distinctly concave, while the internal part has an involute but more nearly plane surface. At the most anterior point of the fossa, hidden by the external corner of the epipterygoid when viewed straight from the ventral aspect, is a foramen and canal, fissura petropterygoidea (Gaupp), leading for-

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[1] The name *Echinda* is certainly invalid and the personal determination of any zoölogist, however eminent, does not make it any less so. It will perhaps survive as a semi-popular name for an animal of which the correct taxonomic name is not generally familiar and the older popular names are grossly misleading. Zeuglodon, eohippus, dinosaur, ameba, mastodon, and other names show that a scientific term once impressed on the laiety by popularization may acquire a vernacular currency which survives, often usefully, despite the scientific invalidity of the word.

[2] Van Bemmelen identifies this as the mastoid process, but it is clearly not homologous with his supposed mastoid process in *Ornithorhynchus* (see below) and in neither case is it fully homologous with the mastoid process usually so-called in other mammals.

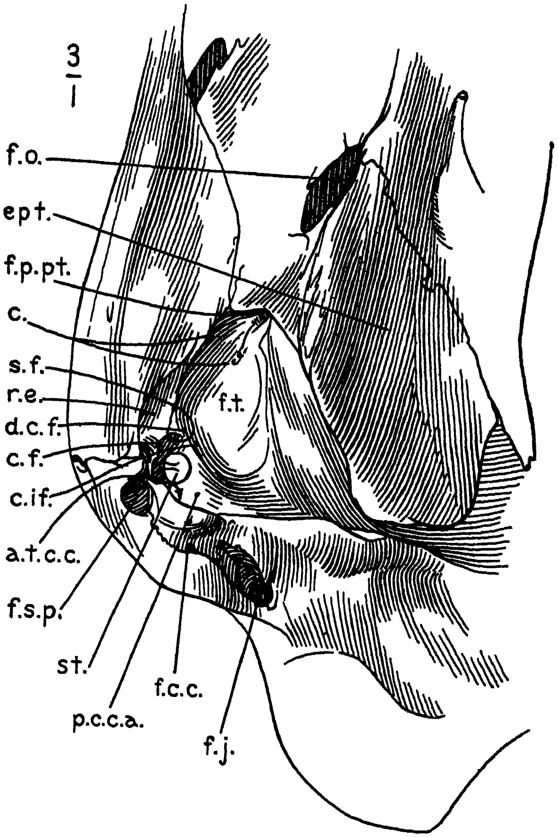

Fig. 1. *Tachyglossus aculeatus.* Ventral view of right side of cranium. Three times natural size.

a.t.c.c., sulcus facialis.
c., dubious canals mentioned on p. 4.
c.f., crista facialis.
c.if., crista infrafacialis.
d.c.f., dehiscentia canalis Fallopii.
ept., epipterygoid.
f.c.c., foramen into canalis craniotympanalis.
f.j., foramen jugulare.
f.o., foramen ovale.
f.p.pt., fissura petropterygoidea.
f.s.p., foramen stylomastoideum primitivum.
f.t., fossa tympanica.
p.c.c.a., pars cochlearis capsulae auditivae.
r.e., recessus epitympanicus.
s.f., apertura tympanica canalis facialis.
st., stapes (in fenestra vestibuli).

ward into the cerebral cavity immediately posterior to the foramen ovale (or pseudovale, Gaupp). External and somewhat posterior to this there are two small foramina opening forward and with shallow grooves leading toward the fissura petropterygoidea. These Gaupp supposed to be for the nervus petrosus superficialis major and the n. p. s. minor, but this can hardly be correct, since at least the more lateral, larger, and more constant of these comes not from the canalis Fallopii but from the canalis proöticus of Gaupp, which would seem to be an impossible course for this nerve.[1]

The posterointernal angle of the tympanic fossa is produced into a deep funnel-like pocket, floored by the epipterygoid, at the end of which is an opening onto the outer surface of the basicranium, near the edge of the basioccipital at the posterior end of the (secondary) palate. This suggests a tuba Eustachii ossea, and has been so identified, but apparently this is incorrect and the canal is vascular. The tuba does indeed depart from this corner of the cavity (and not anteriorly as in other mammals) but is not marked on the bone surface (Eschweiler, Denker). Near the external corner of this main fossa, on the anterior slope of the crista infrafacialis, anterior to the fenestra vestibuli, may appear an oval vacuity, dehiscentia canalis Fallopii (Denker, Van Bemmelen), into the canalis facialis (s. Fallopii), but on my material this is highly variable and may be a mere notch on the crista infrafacialis.

Posteroexternal to the main fossa is a smaller triangular surface, directed outward and downward, in which is the nearly circular fenestra vestibularis. Posterior to this there is a large opening, leading upward, backward, and inward into a large pit or canal with complex features, described below. The opening is the apertura tympanica canalis craniotympanalis (Denker, Van Bemmelen). Externally the surface passes without definite delimitation, except near the anterior end where there may be a low crest, into a broad, curved groove, the sulcus facialis, which carries not only the facial nerve but also a large vein, the vena capitis lateralis. This groove describes an arc of about 90°, the anterior end anteroexternal and the posterior end posteroexternal to the fenestra vestibuli, the posterior end being almost directly posterior to the anterior end and somewhat below the latter. The groove is open into the general tympanic cavity on the internal[1] side, and its floor is formed by a thin, sharp lamella of bone, the crista facialis (s. parotica).

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[1] Watson (1916, p. 340) says that "ramus palatinus [i.e. nervus petrosus superficialis major] runs forward through a hiatus Fallopii, which forms a canal of variable length. It sometimes stretches to the extreme anterointernal corner of the bone." In Pl. xxiv, fig. 3, he labels a "groove and foramen for the great superficial petrosal nerve." The foramen so labeled seems to be the fissura petropterygoidea of Gaupp, which of course cannot be considered a hiatus Fallopii, as it has no direct connection with the canalis Fallopii. The nervus petrosus superficialis major may have left the canal through the so-called dehiscentia canalis Fallopii (see below) but even in this case the latter is very different in position and relationships from a true hiatus Fallopii, such as occurs in *Ornithorhynchus*, and this hiatus seems to be absent as such or very atypical in *Tachyglossus.*

Immediately anterior to the point where the rostral end of the sulcus facialis becomes a closed canal, it divides into two canals. The more medial, somewhat smaller opening, leading into a canal passing medially, is the apertura tympanica canalis facialis.[2] The more lateral and somewhat larger opening leads into a canal that at first passes anteriorly and

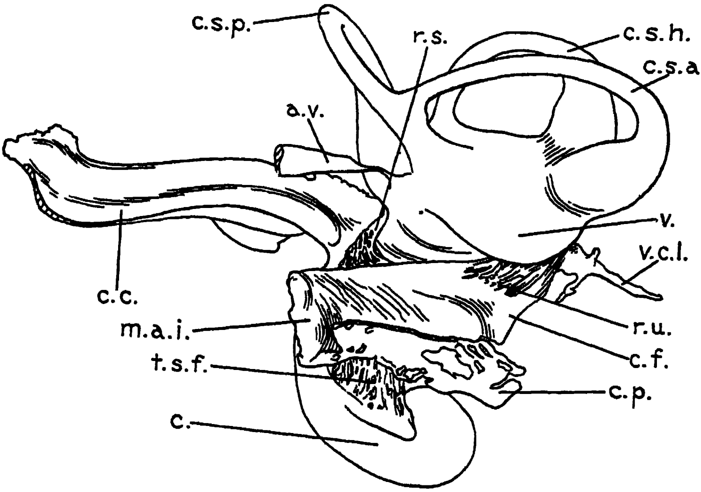

Fig. 2. *Tachyglossus aculeatus.* Internal mold of the inner and part of the middle ear of the left side. Superointernal view. Not to scale. After Denker.

a.v., aqueductus vestibuli.
c., cochlea.
c.c., canalis craniotympanalis.
c.f., canalis facialis.
c.p., pneumatic cells.
c.s.a., anterior semicircular canal.
c.s.h., horizontal semicircular canal.
c.s.p., posterior semicircular canal.
m.a.i., meatus acusticus internus.
r.s., ramus sacculi (of auditory nerve).
r.u., ramus utriculi (of auditory nerve).
t.s.f., tractus spiralis foraminulentus (of auditory nerve).
v., vestibule.
v.c.l., vena capitis lateralis.

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[1] It has been customary to describe the monotreme ear as if it were tilted at 90° or somewhat less, so as to orient it more or less like the ears of higher mammals, lateral rather than ventral in the braincase. In such an orientation, this would be the ventral side. This convention seems to me to lead to endless confusion, and I have throughout described the ear as it is, not as it might be if it conformed with some fictitious rule.

[2] This term has been applied to the slightly more posterior tympanic aperture of both canals after their union, or the two have not been sharply distinguished. The distinction does not seem very important, but strictly this is the actual end of the facial canal as such and the short common canal for nerve and vessels is distinct.

somewhat medially, then turns dorsally, somewhat laterally, and finally posteriorly and then opens into the cranial cavity where the sulcus sinus transversi leads into it. This canal transmits the vena capitis lateralis and is called the canalis proöticus by Gaupp. The intracranial opening is called the foramen vasculosum internum by Van Bemmelen.

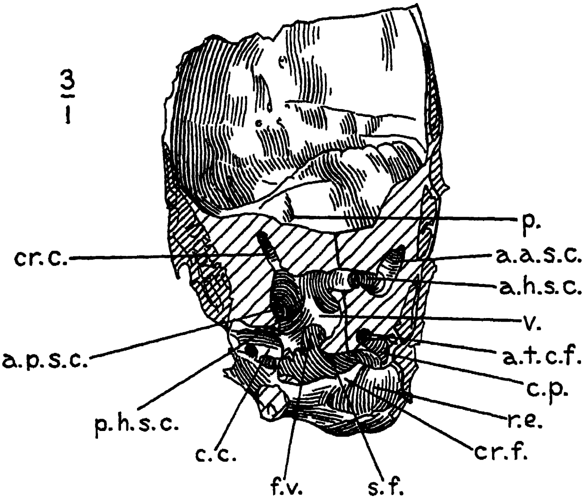

Fig. 3. *Tachyglossus aculeatus.* Skull fragment from the left side, removed by two vertical cuts, one directly anteroposterior and one directly transverse, meeting at the anterointernal corner of the vestibule. The view is almost directly posteroexternal, the cross-lined part to the left being the anteroposterior and that to the right the transverse cut. Above this is the endocranium, in it the inner ear, and below it the middle ear. Three times natural size.

a.a.s.c., recess for ampulla of anterior semicircular canal.

a.h.s.c., recess for ampulla of horizontal semicircular canal.

a.p.s.c., recess for ampulla of posterior semicircular canal.

a.t.c.f., apertura tympanica canalis facialis.

c.c., canalis craniotympanalis.

c.p., canalis prooticus.

cr.c., canal for crus commune.

cr.f., crista facialis.

f.v., fenestra vestibuli.

p., small pit in endocranial aspect of periotic.

p.h.s.c., posterior vestibular aperture of horizontal semicircular canal.

r.e., recessus epitympanicus.

s.f., sulcus facialis.

v., vestibule.

At its posterior end the sulcus facialis turns ventrally and enters an opening lateral to the previously mentioned apertura tympanica canalis craniotympanalis. After passing through a very short canal, hardly worthy of separate designation as such, the passage issues through a circular opening on the base of the skull, approximately at its posteroexternal angle. This is the foramen stylomastoideum (or more accurately the f. s. primitivum; a foramen stylomastoideum, foramen faciale, or foramen stylomastoideum definitivum in the sense of Van Kampen is not formed in monotremes).

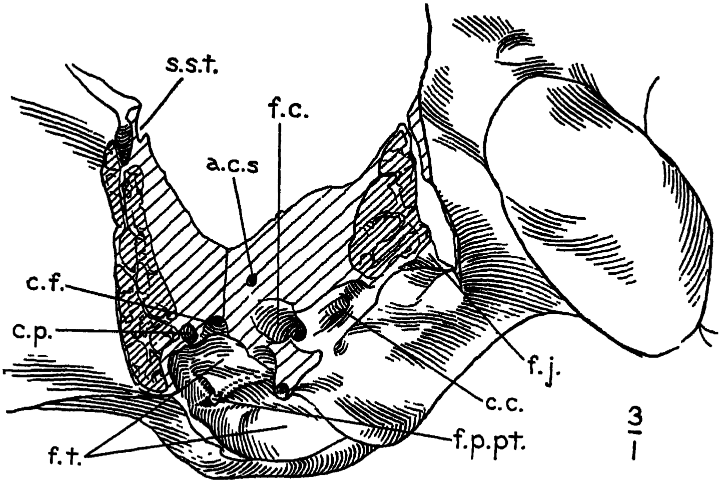

Fig. 4. ***Tachyglossus aculeatus.*** **The sectioned specimen of Fig. 3, showing the skull from which the piece seen in Fig. 3 was cut, looking anterointernally. Three times natural size.**

a.c.s., area cribrosa superior.	**f.j., foramen jugulare.**
c.c., canalis craniotympanalis.	**f.p.pt., fissura petropterygoidea.**
c.f., canalis facialis.	**f.t., fossa tympanica.**
c.p., canalis proöticus.	**s.s.t., sulcus sinus transversi.**
f.c., fossa cochleae.	

Ventral to the sulcus facialis is another sulcus or pocket, also open on the medial side. The roof is formed by the crista facialis posteriorly and by a process of the squamosal anteriorly. The floor is less extensive and is formed mainly by an inflection of the squamosal, met posteriorly by a periotic process from the region of the foramen stylomastoideum. This pocket is the recessus epitympanicus (Van Kampen, Gaupp, etc.; the term has also been less correctly used to include a larger part of the tympanic cavity).

The region dorsal and posterior to those already described includes a complex of cavities to which in general the name canalis craniotympanalis was applied by Denker. Gaupp pointed out that this included the foramen jugulare, which is properly a thing apart, and confined the name canalis craniotympanalis to the opening leading from the tympanic cavity. There does not appear to be any clear description of the details of this region, details which are, indeed, variable but still include characteristic features. The opening already mentioned under the name apertura tympanica canalis craniotympanalis leads into an irregular cavity, not in itself really canal-like. The antero-superointernal edge of the aperture is a well-defined crest, posterointernal to the fenestra vestibuli and above this is a pocket in the bottom of which is an oval aperture, facing postero-inferolaterally, the fenestra cochleae. External and posterior to this there is a rounded expansion of the chamber, with several variable foramina opening into the diploe of the adjacent cancellous bone. Posteriorly and dorsally the cavity narrows somewhat into a canal which opens into the jugular canal near its lower (extracranial)

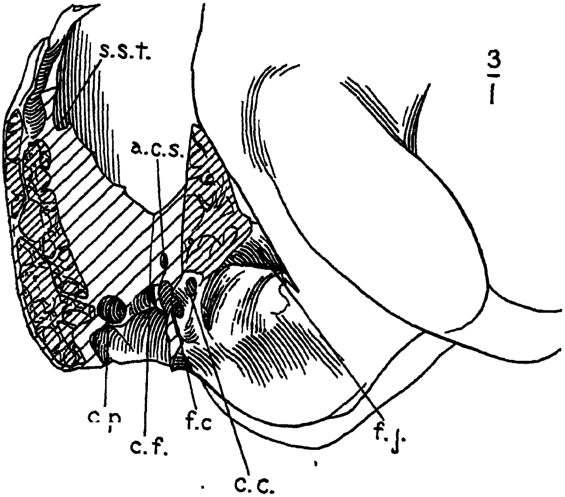

Fig. 5. Same as Fig. 4, looking anteriorly.

a.c.s., area cribrosa superior.
c.c., canalis craniotympanalis.
c.f., canalis facialis.
c.p., canalis proöticus.
f.c., fossa cochleae.
f.j., foramen jugulare.
s.s.t., sulcus sinus transversi.

end. This often has one or two small foramina into the diploe in its walls. The extent to which it is roofed over varies, but there seems rather constantly to be a hiatus in the posterior wall, so that the canal also has an opening distinct from and anteroexternal (and ventral) to the foramen jugulare. There is also a distinct and smaller canal, beginning on the antero-superomedial wall of the main canal, paralleling the latter in a dorso-posteromedial direction, and opening separately into the inner part of the jugular canal. The point of opening varies considerably and in some cases is so far intracranial that it is clearly distinguishable from the jugular canal in an endocranial view and can hardly be said to open into the latter canal, with which it is, nevertheless, closely associated and into which it usually seems to open.

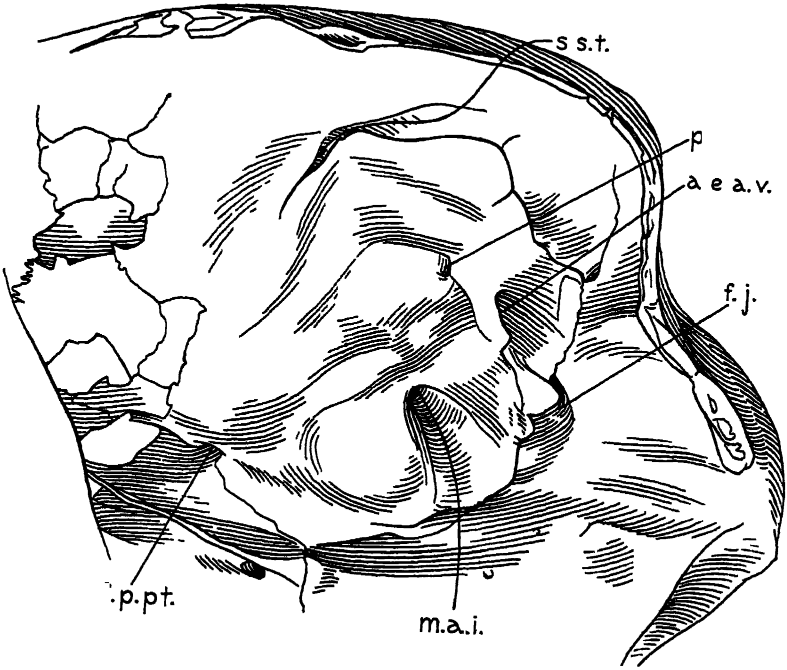

Fig. 6. *Tachyglossus aculeatus.* The endocranial aspect of the right ear region of a skull with the roof cut away. Superointernal view. Three times natural size.

a.e.a.v., endocranial aperture of aqueductus vestibuli.
f.j., foramen jugulare.
f.p.pt., fissura petropterygoidea.
m.a.i., internal auditory meatus.
p., pit in endocranial aspect of periotic.
s.s.t., sulcus sinus transversi.

The internal ear has been well described by Denker, who treats the bony labyrinth of the adult, and by Alexander, who deals with the embryology and histology of the soft tissues, not part of the present subject but useful in interpreting the osteology. Denker figures and describes molds of the cavities, made by filling them with molten metal and then etching away the bone. I here supplement these data by figures of a dissection made by two vertical saw-cuts on the macerated skull, such as to reveal most of the important internal features. In view of the general adequacy of the previous work and clarity of the figures available, not much detail is necessary.

The vestibule proper, or its central portion, is somewhat distinct from a deep posteroexternal pocket, with the opening of the crus commune in its roof, near its (vaguely defined) mouth, and the opening and space for the ampulla of the posterior semicircular canal in its posteroinferior part and the posterior opening of the horizontal canal immediately anteroexternal to this. A similar anteroexternal recess has the large cavity for the ampulla of the horizontal semicircular canal in its outer part, and above and, for the most part, slightly anteromedial to this is the less pronounced fossa for the ampulla of the anterior semicircular canal. On the medial side the vestibule gradually narrows and passes into the large, curved fossa cochleae. As is well known this fossa (in all monotremes) is unique among recent mammals in being nearly uncoiled. That is, it does not complete one whole turn, but it is, nevertheless, spiral. It is more transverse than anteroposterior.

The aqueductus vestibuli (for the ductus endolymphaticus) opens into the roof of the vestibule between the outer end of the fossa cochleae and the opening of the crus commune. Hence the aqueduct, which is very small, runs upward, backward, and inward to its opening on the endocranial aspect of the periotic.

The inner surface of the periotic is rather simple and there is no fossa subarcuata, in sharp distinction from *Ornithorhynchus* and most primitive mammals. The porus acusticus internus is near its posteromedial corner and opens into a true meatus running forward and outward and, in its most lateral part, also upward. This most lateral and somewhat dorsal portion has the beginning of the canalis Fallopii anteriorly, and posterior to this is the area (s. macula) cribrosa superior (or foramen acusticum superius—seen as a foramen in the dissection but cribriform when uncut—)the ducts from which open into the upper part of the medial wall of the vestibule and carry the ramus utricularis (Denker) or nervus utriculo-ampullarus (Alexander, Gaupp). Below these, the meatus is expanded into a pocket which lies parallel to and above the fossa cochleae. In the floor of this are many fine ducts, for the nerve to the cochlea, forming the area cribrosa anterior (Alexander, Gaupp) or tractus spiralis foraminulentus (Denker—this is indeed the homologue of the tractus spiralis, but in monotremes it is not spiral), the successor of a more united foramen acusticum inferius in young animals (Gaupp). At the posterolateral end of this expansion of the meatus is the macula cribrosa inferior (Alexander), successor of the foramen acusticum medium (Gaupp), through which the posterior ampulla and probably also the sacculus are innervated.[1] In my material, and in the various illustrations available, this macula is not very sharply distinguishable from the area cribrosa anterior.

Near the posterior edge of the endocranial surface of the periotic and postero-superolateral to the porus acusticus internus, is an irregular superolateral-inferomedial slit, the apertura externa aqueducti vestibuli, which passes forward into the bone and narrows rapidly to form the minute aqueductus vestibuli. Antero-superolateral to this, and superolateral to the porus, there is sometimes, but not invariably, a small pit, which does not appear to be a foramen or other functional structure. The sulcus sinus transversi is well marked in its curved course leading into the canalis proöticus, already described. Starting at the posterior end of its course is a distinct sulcus and extending postero-inferomedially to the suture with the occipital is a well marked groove or elongate pit. At the edge of the periotic posterior to the porus is the endocranial end of the foramen jugulare (plus the foramen condyloideum, which is not separate in monotremes, and also plus the canalis craniotympanalis) and in an analogous position at the antero-inferomedial border of the periotic is the endrocranial opening of the fissura petropterygoidea.

ORNITHORHYNCHUS

The Ornithorhynchidae are represented by several specimens, juvenile to senile, of the typical *Ornithorhynchus anatinus*, generally considered to be the only living species of the family although others have been proposed. At first sight the ear region in this animal appears to be basically unlike that of *Tachyglossus*, but in fact the structural resemblance proves to be close. Most of the differences are superficial and are dependent on proportions, degree of ossification of various regions, and other features that overlie but do not conceal fundamental agreement such as is consonant with community of origin.

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[1] The various accounts do not seem to be consistent as to the exact distribution of nerves through this area, and the problem cannot be solved osteologically.

The tympanic cavity (and indeed the ear region as a whole) is much smaller relative to the rest of the skull in *Ornithorhynchus* than in *Tachyglossus* and is also rendered less definite and conspicuous by the absence of any elevated rim or other sharp boundary on the medial, anterior, or posterior sides. There is, however, a strong underlapping lamina on the lateral side which is also produced backward as a projection beyond the ear region proper. This is the processus mastoideus of Van Bemmelen, but later revision (Gaupp, Watson, etc.) suggests that this structure as a whole is to be considered as a crista parotica. The medial margin of the anterior part has a large semicircular incisure, above the middle of which is the fenestra vestibuli. The posterior margin of this incisure is formed by a small but stout process directed almost straight medially, at a lower level than the roof of the tympanic recess. This is the processus hyoideus of Van Bemmelen (formed by a tympanohyal according to Van Kampen). Although (on the macerated skull) a gap is left between its inner end and the body of the periotic, it is homologous with the bridge of bone enclosing the foramen stylomastoideum primitivum ventrally in *Tachyglossus*. The medial rim of the incisure and anterior rim of the processus hyoideus are thick and vaguely and slightly excavated. This is suggestive of the much more obvious and larger recessus epitympanicus of *Tachyglossus*, but that recess is not otherwise present and indeed is best recorded, as is usually done, as quite absent as such in *Ornithorhynchus*.[1]

Above the crista parotica, lateral to the fenestra vestibuli, is the large curving sulcus facialis, as in *Tachyglossus*, and, also as in that genus, it is evidently more extensively occupied by blood vessels than by the actual facial nerve. The lateral part of the anterior end leads into a canalis proöticus, quite as in *Tachyglossus*, and there is also a smaller branch that runs anterolaterally and opens on the external surface of the skull, immediately anteromedial to the glenoid fossa, as the foramen vasculosum externum laterale (Van Bemmelen), which Watson states to be for the arteria temporalis superficialis. Medial and somewhat anterior to this is the apertura tympanica canalis facialis. The canalis facialis (s. Fallopii) curves forward, upward, and then backward from this foramen to the internal auditory meatus. Immediately anterior to the periotic in this region is a great opening, larger than in *Tachyglossus*, the foramen pseudovale (including in its functions that of the foramen ovale s. s.), within the rim of which, at its posteroexternal end, is a pronounced recess on the anterior side of the anterolateral part of the strictly auditory region of the periotic. In the posterior wall of this recess there is a marked hiatus in the facial canal (hiatus canalis Fallopii, Denker, etc.), which thus is open anteriorly in about the middle of its course from the internal auditory meatus to its tympanic aperture. The position of this hiatus is different from that of the dehiscentia canalis Fallopii of *Tachyglossus*, which it may otherwise resemble, for the latter is within the tympanic cavity.

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[1] This is clearly brought out by Van Kampen and Gaupp and accepted by most later students, but earlier writers usually did not clearly distinguish between the recessus epitympanicus and the groove called the sulcus facialis by Van Kampen and most subsequent workers, and this confusion is still occasionally encountered.

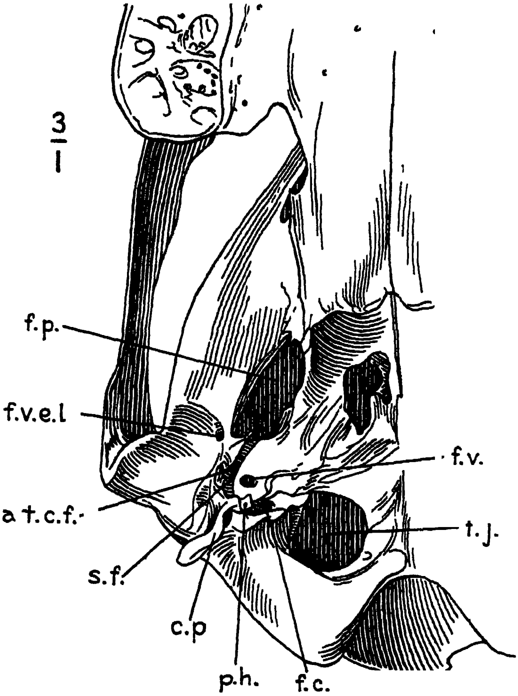

Fig. 7. *Ornithorhynchus anatinus.* Right part of the basicranium, seen from below and somewhat internally. Three times natural size.

a.t.c.f., apertura tympanica canalis facialis.
c.p., crista parotica.
f.c., fenestra cochleae.
f.j., foramen jugulare.
f.p., foramen pseudovale.
f.v., fenestra vestibuli.
f.v.e.l., foramen vasculosum externum laterale.
p.h., processus hyoideus.
s.f., sulcus facialis.

The nearly closed notch above the processus hyoideus is evidently homologous with the foramen stylomastoideum primitivum in its lateral part and with the apertura tympanica canalis craniotympanalis of *Tachyglossus* in its medial part, although in *Ornithorhynchus* the two are not separated from each other by a bridge of bone and the two together are not entirely enclosed by bone. They are, however, divided by a small sharp nearly anteroposterior ridge (slightly more medial anteriorly) in the roof of the common passage. There is a pit dorsal and posterior to what I consider as structurally the a. tymp. can. craniotympanalis, and the fenestra cochleae opens posteriorly into this. An open groove runs internally from the pit into the great vacuity which includes the foramen jugulare; compare in *Tachyglossus* the more enclosed and more posterior but structurally similar connection.

The bony labyrinth has been fully described by Denker. It is similar to that of *Tachyglossus* and offers so few peculiarities that no additional description seems necessary.

The endocranial aspect of the ear region is sharply distinguished from that of *Tachyglossus* by the development of a pronounced shelf with a sharp (medial) rim below the sulcus sinus transversi and of an unusually large and deep fossa subarcuata, the mouth of which is approximately triangular. The anterior semicircular canal runs within its anterosuperior rim and the crus commune within the likewise sharp posterior rim. In the anterior wall of the fossa there is a short canal into the sinus sulcus transversi, near the endocranial end of the canalis prooticus. The apertura externa aqueducti vestibuli is a small opening, not enlarged or slit-like as in *Tachyglossus*, on the eminence below the inferomedial angle of the rim of the fossa subarcuata. The porus acusticus internus is a pit, without a definite meatus as in *Tachyglossus*, antero-inferomedial to the fossa subarcuata and considerably smaller than the latter.

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AMERICAN MUSEUM NOVITATES

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THE AFRICAN LAUXANIIDAE (DIPTERA)

BY C. H. CURRAN

The number of described species of Lauxaniidae (Sapromyzidae) from Africa is quite small in comparison with the other continents, only about forty species being described up to the present time. Since collections before me contain a number of undescribed forms and representatives of genera not previously known from the Ethiopian Region a review of the species is given.

KEY TO GENERA

1.—Scutellum greatly enlarged, concealing the abdomen......................12.
Scutellum not enormously enlarged.................................2.
2.—Only one pair of frontal bristles.......................*Katalauxania* Hendel.
Two pairs of frontal bristles.................................3.
3. Face convex in profile at least in the middle, the third antennal segment not elongate.................................4.
Face straight or concave in profile, if slightly convex the antennae elongate...8.
4. Front produced forward and more prominent than the face................5.
Front not produced.................................6.
5. Ocelli situated far forward, on the top of the frontal swelling..*Turriger* Kertesz.
Ocelli situated behind the middle of the front................*Cestrotus* Loew.
6. Anterior frontal bristles situated much closer to each other than the upper pair and strongly decussate...........................*Physegenua* Macquart.
Anterior frontals practically as close to the orbits as the upper pair..........7.
7. Occiput concave behind the eyes..................*Afrolauxania*, new genus.
Occiput convex.................................*Pachycerina* Macquart.
8. Parafacials with group of hairs above................*Amphicyphus* deMeijer.
Parafacials without hair.................................9.
9.- Third antennal segment long and narrow, at least three times as long as wide.10.
Third antennal segment elongate oval, seldom twice as long as wide.......11.
10.—First antennal segment fully as long as the second.........*Lauxania* Latreille.
First antennal segment much shorter than the second....*Halidayella* Hendel.
11.—The short, black setulae are continued along the costa to the tip of the third vein.................................*Homoneura* Wulp.
These setulae extend to at most halfway between the second and third veins.
Sapromyza Fallen
12.—Discal and second basal cells united.....................*Acelyphus* Malloch.
A crossvein separating the discal and second basal cells.....*Celyphus* Dalman.

KATALAUXANIA HENDEL

There is but one described species belonging to this genus.

Katalauxania variipennis Hendel

HENDEL, 1925, Encyl. Ent., Ser. B., Dipt. II, p. 133.

Described, apparently from a single specimen, from Kilimandjaro, East Africa. It is unknown to me.

CESTROTUS LOEW

This genus is easily recognized by the long, convex face, wide cheeks and protuberant front, the ocellar triangle being situated well back, but still far before the vertex. In the closely related *Turriger* Loew the ocellar triangle is situated far forward on the frontal tubercle. *C. megacephalus* Loew is the genotype.

TABLE OF SPECIES

1.—Front with yellow spot above each antenna.................... ....2.
Front wholly opaque black immediately above the antennae.
cuthbertsoni, new species.

2.—Apex of the wing broadly brownish gray; face brownish in ground color; basal antennal segments brown............ ....*megacephalus* Loew.
Apex of the wing cinereous hyaline; face yellowish on lower half, basal antennal segments more than half reddish................ ....*variegatus* Loew.

Cestrotus cuthbertsoni, new species

Figure 1

MALE.—Front almost twice as wide as long, the anterior third black, the broad sides and the anterior margin opaque black, the median third densely gray pollinose, the upper third brown except along the orbits; the anterior bristles arise from small grayish-brown spots that are not clearly connected with the gray pollen; the long ocellars are situated conspicuously in front of the anterior ocellus and the postocellars are long and cruciate; verticals and outer verticals strong. Occiput black, thickly gray pollinose. Face and cheeks brownish red, thickly white pollinose. Cheeks with an outstanding bristle below; facial ridges with a row of short, black hairs. Face evenly convex below, above with an opaque brownish-black fascia that leaves a transverse yellow, thickly silvery white pollinose spot on each side opposite the antennae. Palpi brown. Antennae brown, the third segment brownish red on more than the lower half; arista brown, moderately long plumose.

Thorax black in ground color, densely cinereous white pollinose, the mesonotum mostly brown. The brown of the mesonotum consists of very broad sublateral vittae that are more or less united with the extremely broad but irregular median vitta, and an additional two or three brown dashes toward each side. The scutellum is gray pollinose with three small brown spots basally, the lateral ones round, the median one elongate. The prescutellars are strong and there are only two pairs of strong dorsocentrals.

Legs brown, cinereous pollinose, the tarsi reddish, becoming brown apically, the anterior tibiae brownish red.

Wings grayish brown and cinereous hyaline, as in figure 1. Squamae white. Halteres yellow.

Abdomen black in ground color, brown and pale pollinose. The pale pollen is grayish basally but becomes whitish toward the apex of the abdomen. First segment brown, the second to fourth with the apices very broadly brown and each with a broad median vitta; fifth and sixth segments with brown median vitta, the fifth with just the apex brown; seventh segment reddish in ground color. Genitalia brownish, with pale pollen.

HOLOTYPE.—Male, Chirinda Forest, November, 1930 (A. Cuthbertson).

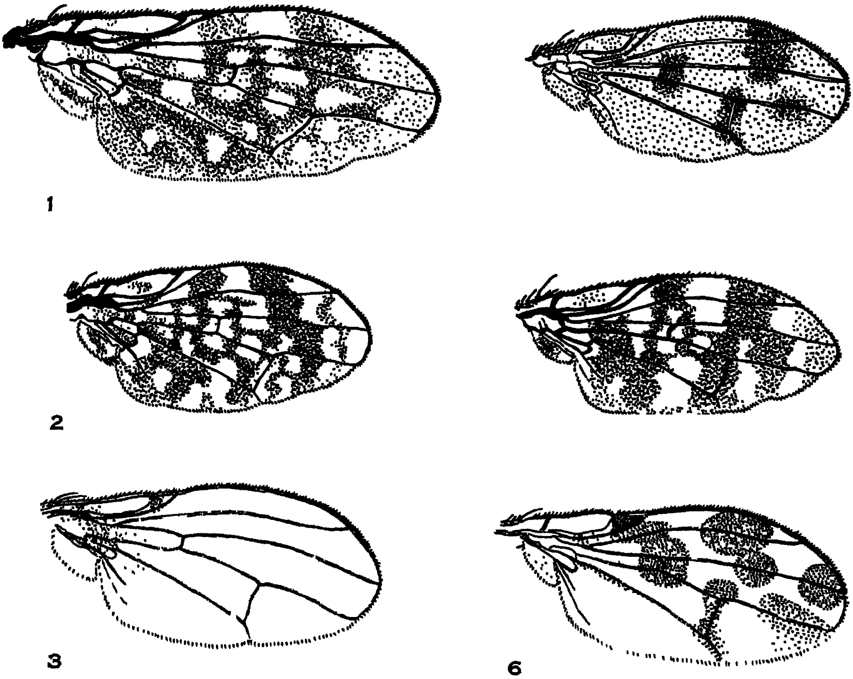

Fig. 1. *Cestrotus cuthbertsoni*, n.sp. Fig. 2. *C. variegatus* Loew. Fig. 3. *Afrolauxania bequaerti*, n.sp. Fig. 4. *Homoneura laxifrons*, n.sp. Fig. 5. *Cestrotus megacephalus* Loew. Fig. 6. *Homoneura cuthbertsoni*, n.sp.

Cestrotus megacephalus Loew

Figure 5

LOEW, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 11.

Two females Msenge River, Eldorado, Southern Rhodesia, October, 1923 (W. L. Williams); male, Chirinda Forest, S. Rhodesia, November, 1930 (A. Cuthbertson).

Cestrotus variegatus Loew
Figure 2

Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 11.

Male, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson).

Cestrotus tibialis Bezzi

Bezzi, 1908, Boll. Soc. Ent. Ital., XXXIX, p. 126.

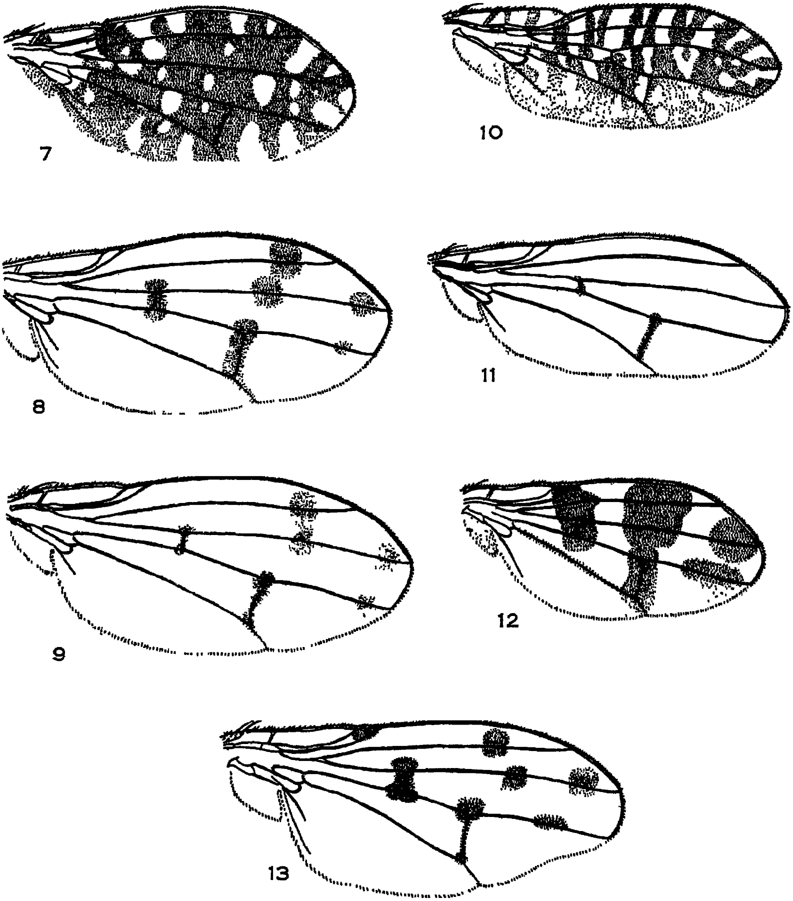

Fig. 7. *Homoneura bequaerti*, n.sp. Fig. 8. *H. rhodesi*, n.sp. Fig. 9. *H. alexis*, n.sp. Fig. 10. *Amphicyphus africanus*, n.sp. Fig. 11. *Homoneura chapini*, n.sp. Fig. 12. *H. liberia*, n.sp. Fig. 13. *H. africana* Adams.

This species was described from Eritrea. It is said to differ from *megacephalus* by the presence of four white spots on the anterior of the front (*megacephalus* has two, from which the bristles arise) and the color of the tibiae. The tibiae of Loew's species are variable in color. *C. variegatus* has four white spots, one on each side of the front immediately above the opaque black lateral spots. Without specimens *tibialis* cannot well be placed in a key.

TURRIGER KERTESZ

This genus is very similar in appearance to *Cestrotus* but the ocelli are placed far forward on the front, being located on the top of the obtusely triangular median projection. There is only one known species from Africa.

Turriger turritus Loew

Cestrotus turritus LOEW, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 10.

PHYSEGENUA MACQUART

Physogenia auct.

It is doubtful that this genus occurs in the Ethiopian Region. I have tentatively placed the two described species in *Afrolauxania.*

AFROLAUXANIA, NEW GENUS

Very similar to *Physegenua* Macquart but at once distinguished by the presence of strong acrostical bristles and the position of the anterior frontals. Differs from *Pachycerina* Macquart by the concave occiput. In *Pachycerina* the back of the head is convex behind the upper half of the eyes and there are bristles directly behind the ocelli.

Face and front convex and on nearly the same plane. Two pairs of frontals, the anterior pair only slightly weaker than the posterior, situated only slightly nearer to each other and at most weakly convergent; ocellars absent; postocellars situated well outside the ocellar triangle; back of head concave; facial ridges with two or three hairs below the middle in addition to the usual row extending forward from the cheeks; first antennal segment shorter than the second; arista short plumose. Thorax with the following bristles: two sternopleurals, four scutellars, four acrosticals, three dorsocentrals, one presutural, one humeral, two notopleurals, two supra-alars and one on the posterior calli. Legs, wings and abdomen normal for the family.

GENOTYPE.—*A. bequaerti*, new species.

Judging from the descriptions *Physegenua submetallica* Loew and *P. bimaculata* Adams belong to this genus. The latter has been placed as a synonym of *submetallica* by Speiser, probably correctly so, but Loew's description is very brief and the two may be distinct.

TABLE OF SPECIES

1.—Scutellum with two black spots....................................2.
Scutellum wholly yellow.... ....*bequaerti*, new species.
2.—Anterior crossvein clouded with brown..................*submetallica* Loew.
Anterior crossvein not clouded with brown ....*bimaculata* Adams.

Afrolauxania bequaerti, new species

Figure 3

Yellowish, with blackish abdomen. Length, 4 mm.

MALE.—Head yellow, the face and front shining rusty reddish; palpi reddish yellow. Antennae brownish red, the arista mostly black, short plumose.

Thorax yellow, the dorsum slightly darker than the pleura and with very thin whitish pollen.

Legs wholly yellow.

Wings cinereous hyaline, with luteous tinge, light brown toward the base. Squamae yellow. Knobs of halteres brownish red.

Abdomen brown, perhaps partly stained. Genitalia brownish red.

HOLOTYPE.—Male, Du River Camp No. 3, Liberia (J. Bequaert).

PACHYCERINA MACQUART

There is but one described species from Africa.

Pachycerina vaga Adams

ADAMS, 1905, Kans. Univ. Sci. Bull., III, p. 172.

The species was described from Southern Rhodesia but does not seem to have been collected since.

AMPHICYPHUS DE MEIJERE

This genus is known from the Indo-Australian region but I have a representative from Africa. It is peculiar because of the presence of long, erect hairs on the head.

Amphicyphus africanus, new species

Figure 10

Yellowish, brown and grayish, the wings brown and whitish. Length, about 3 mm.

MALE.—Front rusty yellow, the bristles arising from reddish-brown spots, the anterior bristles somewhat convergent; anterior half with long hairs, those on the middle section convergent, the ones on the parafrontals in not more than two rows; ocellars long. Occiput, face and cheeks yellow, the face with two brown orbital spots on each side, one opposite the antennae, the second near the lower edge of the eye, and three small ones on the oral margin, the lateral oral margin with a brown spot in front. Occiput with long bristly hairs that extend along the cheeks and onto the oral angles, the parafacials with a tuft of hairs near the upper border. Proboscis brownish yellow, the palpi yellow, slender. Antennae yellowish, the third segment tapering to a point and curved upward; arista pubescent, brown apically.

Mesonotum reddish and brown, the brown predominating outside the dorsocentrals but crossed in several places by gray or reddish yellow, the pale median area crossed by rather wide brownish red spots. Scutellum brown with cinereous pollen that leaves a broad irregular brown band across the middle, in shape, strongly narrowed to near the middle, the sides thence almost parallel to the truncate, medianly sulcate apex. The hairs and bristles are long. There are five pairs of acrosticals and four pairs of dorsocentrals.

Legs yellow, the femora each with a broad brown band near the apical third, the anterior four with brownish basal bands, the tibiae with bands near the basal and apical third, tarsi brownish yellow.

Wings pale brownish and whitish as in figure. Squamae pale yellow, with darker border. Halteres yellow.

Abdomen yellowish, the bristles each arising from moderately large brown spot, the second and following segments with rather narrowly separated paired, basal brown spots, those on the second segment larger and partly united, the first segment broadly brown in the middle on its whole length. The pale areas are covered with yellowish-white pollen. The hairs are sparse and erect.

HOLOTYPE.—Male, Du River Camp No. 3, Liberia (J. Bequaert).

LAUXANIA LATREILLE

The following table contains only the species described by Loew and the undescribed forms before me. It is probable that most of them belong to *Halidayella*.

TABLE OF SPECIES *Lauxania* AND *Halidayella*

1.—Halteres with black knob..2.
Halteres pale..4.
2.—Thorax metallic green..................................*L. torso*, new species.
Thorax not bright green, though with metallic reflections..................3.
3.—Arista with long rays..................................*gagatina* Loew.
Arista almost bare..................................*atrovirens* Loew.
4.—Pleura reddish..................................*chlorogastra* Loew.
Pleura black or brown..5.
5.—Face shining..................................*H. indecora* Loew.
Face pale pollinose..6.
6.—Sides of the mesonotum reddish........................*? anceps*, new species.
Mesonotum wholly dark..7.
7.—Anterior border of the front reddish, tarsi reddish...............*oblonga* Loew.
Front wholly shining black; front tarsi black with the first segment whitish. *clypeata* Loew.

Lauxania torso, new species

Legs reddish, the front tibiae and tarsi black; wings slightly yellowish in front. Length, 3.5 mm.

MALE.—Front brown below, blue-green on more than the upper half, the orbits more or less violaceous; median third of the upper portion whitish pollinose except for a wedge extending forward from the ocellar triangle. Occiput blue, white pollinose on the lower half; cheeks and face bronze black, the orbits white pollinose. Palpi brown. Basal antennal segment yellow, the others missing.

Thorax green, the sides of the mesonotum more or less cyaneous, the whole thinly cinereous pollinose. Three pairs of dorsocentrals; anterior sternopleural weak.

Legs reddish, the anterior tibiae and tarsi black; all coxae pale.

Wings cinereous hyaline, slightly yellowish in front; veins yellowish. Knob of halteres brown.

Abdomen bronze black, shining; hair wholly black.

HOLOTYPE.—Male, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson).

Halidayella indecora Loew

Lauxania indecora LOEW, 1862, Ofvers. Kongl. Vet. Akad., XIX, p. 10. South Africa.

Greenish black, the thorax with cinereous brown and cinereous pollen; legs mostly reddish yellow. Length, 3 to 3.5 mm.

Front rather dull blackish, the broad orbits shining blackish green on the upper two-thirds. Occiput black, whitish pollinose on the lower half; cheeks and face shining metallic black, the orbits whitish pollinose. Antennae reddish yellow with the third segment almost all black; arista brown, pubescent, broadly reddish yellow basally.

Thorax greenish black, rather thinly cinereous brown pollinose above and cinereous pollinose on the sides and sternum. Three pairs of dorsocentrals; anterior sternopleural moderately strong.

Legs reddish yellow, the anterior tibiae and tarsi black; posterior four femora blackish on more than the basal half; posterior four coxae brown with pale apices.

Wings with slight luteous tinge, the veins yellow. Halteres and squamae yellow.

Abdomen shining blackish green; hair black.

Male and female, Salisbury, Southern Rhodesia, February, 1932 (A. Cuthbertson).

Lauxania? anceps, new species

Blackish, the head and thorax partly reddish yellow; legs yellowish. Length, 5.5 mm.

MALE.—Front and upper third of the occiput shining black, a spot of white pollen above the neck; outer verticals long. Occiput, cheeks and face reddish yellow, the facial orbits white pollinose. Face rather strongly receding, not convex, the oral margin not produced. Proboscis brown; palpi black. Antennae wholly black, situated on the prominently produced juncture of the face and front, their base much more produced in front of the eyes than in other species; arista white, rather strongly pubescent.

Thorax shining brownish black, very thinly brownish pollinose, the sides of the mesonotum broadly yellow in front of the wings, the metanotum and upper part of the pleura behind the wings reddish yellow. Two pairs of dorsocentrals; anterior sternopleural weak.

Legs reddish yellow, the front tarsi and apices of the middle pair brown; anterior coxae yellow, white pollinose.

Wings pale luteous, more yellowish basally, the veins yellow. Squamae and halteres yellowish.

Abdomen shining black; black-haired.

Holotype.—Male, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson).

This species can scarcely remain in *Lauxania* but it seems advisable to retain it here for the present.

Additional Species of *Lauxania*

atrovirens Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 9 (South Africa).

chlorogaster Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 10 (South Africa).

clypeata Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 9 (South Africa).

crinicornis Thomson, 1868, 'Eugenies Resa,' p. 568 (Mauritius).

elisae Meigen, 1826, 'Syst. Beschr. Eur. Dipt.,' V, p. 297 (Europe). Adams, 1905, Kans. Univ. Sci. Bull., III, p. 175 (Southern Rhodesia). The identification should be verified.

flavipes Bezzi, 1908, Boll. Soc. Ent. Ital., XXXIX, p. 128 (Eritrea).

gagatina Loew, 1852, Berichte Kongl. Akad. Berlin, p. 661 (Mozambique); 1862, Peter's 'Reise Mozambique,' V, p. 32.

metallica Wiedemann, 1830 'Aussereur. Zweifl.,' p. 662 (South Africa).

oblonga Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 10 (South Africa).

Homoneura Wulp

The following key contains only species known to belong to this genus. Almost all of the species listed under *Sapromyza* probably belong here.

Table of Species

1.—Wings with dark markings in addition to those on the crossveins............2.
Wings with dark markings only on the crossveins........*chapini*, new species.
2. Abdomen yellowish, with a median row of brown spots apically and sometimes lateral spots..3.
Abdomen differently marked...5.
3.—Abdomen with lateral spots on each segment......*obliquepunctata* Macquart.
Abdomen without lateral spots...4.
4.—Front wider than long..................................*trinotata* Loew.
Front slightly longer than wide........................*rhodesi*, new species.
5.—Costal border of the wing broadly brown, at most an indistinct pale spot at the apex of the second vein..13.
Costal border not uniformly brown.....................................6.
6.—Abdomen with black or brown markings................................9.
Abdomen wholly pale...7.
7.—Wings with four brown spots.........................*laxifrons*, new species.
Wings with five or six spots..8.

8.—Scutellum reddish brown, with border and median line yellow... *loewi* Malloch.
Scutellum wholly yellowish.............................*alexis*, new species.
9.—Wings brown with many pale markings (Fig. 7).........*bequaerti*, new species.
Wings differently marked.................. 10
10.—Sides of scutellum brown, at least basally........ ... .11.
Sides of scutellum wholly yellow............. ....*bilineata* Speiser.
11.—Brown spots on wings rather small and isolated.. . ...*africana* Adams.
Brown spots larger and some fused............ .. . .12.
12.—Wings with a practically continuous brown fascia beyond the middle.
liberia, new species.
Wings without such fascia (Fig. 6)..................*cuthbertsoni*, new species.
13.—Middle of mesonotum very broadly pale..................*terminalis* Loew.
The white vittae are separated by a geminate brown median vitta.
guttulata Macquart.

Homoneura chapini, new species

Figure 11

Rusty reddish, the abdomen with two black spots on each side, the wings darkened only on the crossveins. Length, 4 to 4.5 mm.

FEMALE.—Head dull rusty reddish, the posterior orbits pale on the lower half; front with a pair of thinly pollinose pale vittae in which the frontals are placed. Front a little longer than wide, on the anterior two-thirds with sparse, tiny black hairs; ocellars minute. Palpi reddish. Antennae rusty reddish, the arista mostly black and short black plumose.

Thorax rusty reddish, the margin of the scutellum paler. Pollen yellowish gray, not concealing the ground color; no dark vittae. Three pairs of dorsocentrals.

Legs reddish yellow; anterior femora with weak comb on apical half of anteroventral surface.

Wings cinereous hyaline or with luteous tinge, the crossveins clouded with pale brown. Squamae brownish red, the border blackish exteriorly, the fringe rather golden or tawny. Halteres yellow.

Abdomen rather shining, with very thin yellowish pollen, sides of fourth and fifth segments with round, opaque black spot, those on the fourth segment large; second segment with indications of a large, median brown spot on the anterior half. Each segment with a row of marginals.

TYPES.—Holotype, female, Lukolela, Belgian Congo, January 13, 1931 (J. P. Chapin). Paratype, female, Du River Camp No. 3, Liberia (J. Bequaert).

Homoneura obliquepunctata, Macquart

Sapromyza obliquepunctata MACQUART, 1846, 'Dipt.-Exot.,' Suppl. I, p. 204 (f).

I have not seen this species. It is apparently related to *rhodesi* new species, but differs by possessing black spots on the sides of the abdominal segments and in lacking the subapical brown spot on the third longitudinal vein. It was described from the Cape and should be easily recognized.

It is possible, of course, that this species does not belong to *Homoneura* although its general characteristics indicate that it does.

Homoneura trinotata Loew

Sapromyza trinotata LOEW, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 8.

Originally described from Caffraria. I have a single specimen, Izumu to Penge, Belgian Congo (J. Bequaert).

The wings have five pale brown spots, that on the fourth vein being in line with the one on the apex of the second vein and the anterior end of the posterior crossvein; the spot of the fourth vein is somewhat closer to the wing margin than to the crossvein. The posterior crossvein is straight and transverse and is evenly bordered with brown. The apical three abdominal segments each have a blackish median spot resting on the base, the apices of spots rounded. The ocellar bristles are moderately long.

Homoneura rhodesi, new species

Figure 8

Rusty reddish yellow; abdomen with incomplete median brown vitta; wings with six brown spots. Length, 4.5 mm.

FEMALE.—Face and front yellowish white, the frontal vitta yellow; occiput reddish yellow. Front distinctly longer than wide, with tiny blackish hairs on the anterior two-thirds; ocellars long and strong. Palpi yellow. Antennae reddish, the arista brown and short plumose.

Thorax yellow, the dorsum rusty reddish and with grayish-yellow pollen that does not obscure the ground color. The mesonotum bears a pair of broad obscure reddish-brown vittae lying just inside the dorsocentrals and the scutellum is of the same color except on the border and a slender median line. Three pairs of dorsocentrals.

Legs yellowish; anterior femora with a very weak comb on the apical third.

Wings cinereous hyaline, tinged with luteous in front, and bearing six brown spots, one over each of the crossveins, one on the end of the second vein and one slightly before it on the third vein, and spots before the apices of the third and fourth veins. Squamae rusty reddish, with tawny fringe. Halteres yellow.

Abdomen rusty reddish yellow, very thinly pollinose, the third, fourth and fifth segments each with median apical brown triangles that extend forward to form an interrupted, incomplete median vitta. Marginals on the second segment weak and not conspicuous.

HOLOTYPE.—Female, Salisbury, Southern Rhodesia, August, 1932, in house (A. Cuthbertson).

Homoneura terminalis Loew

Sapromyza terminalis LOEW, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 8.

Sapromyza sexvittata CURRAN, 1926, Bull. Amer. Mus. Nat. Hist., LVII, p. 350 (f.).

A well-marked and striking little species, readily recognized by the brown costal border, the strong brown streak along the fifth vein and the arrangement of the brown spots.

H. terminalis was originally described from Caffraria and redescribed as *sexvittata* from the Belgian Congo. I have a specimen from Victoria Falls, June 3, 1932 (A. Cuthertson) and one from Salisbury, Southern Rhodesia, April 20, 1932 (M. C. Mossop).

Homoneura guttulata Macquart

Sapromyza guttulata Macquart, 1846, 'Dipt. Exot.,' Suppl. I, p. 203 (f.).
Sapromyza guttulata Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 9.

This species is rather similar to the preceding but there is no brown stripe along the fifth vein and there are twelve isolated or semi-fused brown spots. It is unknown to me but should be readily recognized from Macquart's figure.

Homoneura laxifrons, new species

Figure 4

Rusty reddish yellow, the wings with four brown spots. Length, 4.5 mm.

Male.—Face, cheeks and lower half of the occiput yellowish, with white pollen, the upper half of the occiput and front dull rusty reddish. Front wider than long, without black hairs, the bristles arising from low tubercles; ocellars moderately long. Palpi yellow. Antennae reddish, the third segment mostly reddish brown; arista black except at the base, medium long plumose.

Thorax rusty reddish, becoming yellow beneath. Three pairs of dorsocentrals.

Legs reddish yellow; fine comb of the front femora occupying a little more than the apical third.

Wings cinereous hyaline, with four brown spots. The anterior and posterior crossveins are broadly bordered with brown, there is a large rectangular spot extending back from the costa from before the apex of the second vein to the middle of the apical cell and there is an oval spot on the middle of the apical section of the fourth vein. Squamae reddish brown, with tawny fringe. Halteres yellow.

Abdomen rusty reddish yellow, very thinly pollinose. Second segment without distinct marginals except laterally.

Holotype.—Male, Melsetter, Southern Rhodesia, October, 1934 (No. 3818).

Homoneura loewi Malloch

Malloch, 1931, Ann. Mag. Nat. Hist., VIII, p. 445.

I have not seen this species, described from Southern Nigeria.

Homoneura alexis, new species

Figure 9

Rusty reddish yellow, the mesonotum with traces of two dark vittae; wings with five or six pale brownish spots. Length, 4.5 mm.

MALE.—Head yellow, yellowish-white pollinose, the upper half of the occiput and the frontal vitta pale orange. Front longer than wide, with scattered tiny black hairs; ocellars as long as the front. Palpi yellow. Antennae dull orange, the arista black, short plumose. Ocellars long.

Thorax yellowish, the mesonotum very pale brownish and brownish-yellow pollinose, with traces of two narrow dark vittae lying just inside the dorsocentrals.

Scutellum brownish yellow. Three pairs of dorsocentrals.

Legs reddish yellow, the weak comb on the anterior femora covering the apical two-fifths.

Wings cinereous hyaline, with yellowish veins and five or six pale brownish spots, the spots on the end of the second vein and on the one behind it more or less fused.

Abdomen rusty reddish yellow, moderately shining, the second segment without marginals except at the sides.

HOLOTYPE.—Male, Victoria Falls, Southern Rhodesia, June 3, 1932 (A. Cuthbertson).

Homoneura bequaerti, new species

Figure 7

Wings brown with white spots, thorax mottled brown and cinereous; femora brown. Length, 4 mm.

FEMALE.—Front wider than long, the vitta reddish yellow with a broad brownish red or pale brownish vitta on each side, the brown stripes varying in width but never reaching the anterior margin or vertex; broad orbits and vertex thickly cinereous pollinose; ocellar triangle blackish and with brown pollen; ocellars long. Occiput brown on the upper half, except below the vertex, and behind the mouth; posterior orbits, lower half of the occiput and cheeks white pollinose, the orbits with a large brown spot opposite the middle of the eye and a smaller one behind their upper angles. Face brownish with a broad brownish-yellow band across the middle, and the oral margin pale. Palpi brown. Antennae reddish, the third segment mostly black, arista brown with yellow base, moderately long plumose.

Thorax mostly brown in ground color; mesonotum thickly cinereous pollinose with rather variable brown markings. There is a pair of brown lines in front that are triangularly expanded in front of the suture, a line extending back inside the humeri and turning inward at right angles, a very broad and very irregular brown band behind the suture and a large spot on each side in front of the scutellum. The scutellum is brown with the base and sides yellow. The pleura are mostly brown, with an upper and median broad grayish stripe; incisures in part broadly yellow. The bristles all arise from dark spots, except those on the base of the scutellum. Three pairs of dorsocentrals.

Legs yellowish, the basal half of the anterior femora, the posterior four except their apices, and the coxae brown or blackish. The comb on the front femora occupies about the apical half.

Wings brown and whitish, as in figure. Squamae whitish, brown apically. Halteres pale yellow.

Abdomen brown and yellowish. First segment brown, the second brown with a broad, medianly interrupted yellowish apical fascia. Third, fourth and sometimes the fifth segments with a very broad median yellow vitta and the apices yellow, the yellow expanding laterally to occupy most of the segment; fifth segment wholly yellow. The brown spots are narrowest on the third segment and may occupy all of the fifth except the apex and the yellowish sides. The pale areas are white or cinereous-white pollinose. Second segment with weak, subappressed marginals.

TYPES.—Holotype, female, Lukolela, Belgian Congo, November 6, 1930 (J. P. Chapin). Paratype, female, Du River Camp No. 3, Liberia (J. Bequaert).

Homoneura bilineata Speiser

Lauxania bilineata SPEISER, 1910, 'Kilimandjaru-Meru Exped.,' X, p. 173.

Rusty reddish yellow, the abdomen extensively black; wings with five black spots, the median two forming a broad fascia; mesonotum brown vittate. Length, 4.5 mm.

MALE.—Front slightly longer than wide, pale orange, the frontal stripes yellowish; ocellars long. Face, cheeks and lower half of the occiput yellow, with yellowish white pollen. Palpi yellow. Antennae reddish, the third segment largely brownish red; arista black, rather short plumose.

Thorax yellowish, the dorsum rusty reddish, with rather thin cinereous white pollen and with a pair of broad vittae that are broadly united or at most separated by a line in front of the scutellum. Scutellum brown with the border and a median line reddish yellow. Three pairs of dorsocentrals.

Legs reddish yellow; fine comb on front femora limited to apical third.

Wings cinereous hyaline, with luteous tinge in front, the veins luteous; five brown spots, a large one surrounding the anterior crossvein, a large, subrectangular spot inside the tip of the second vein that is weakly separated from the large cloud over the posterior crossvein, a semi-orbicular spot on the end of the third vein, and a small, pale spot before the end of the fourth vein.

Abdomen black and rusty reddish. Each segment is apparently black apically, the black extending to the base of the segment in the middle and gradually narrowing to the sides. The under surface is almost all rusty reddish. Pollen cinereous white, very thin. Marginal bristles subappressed and weaker than usual.

MALE.—Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson), No. 2883.

Homoneura africana Adams

Figure 13

Sapromyza africana ADAMS, 1905, Kans. Univ. Sci. Bull., III, p. 171.

A dark-colored species, the mesonotum brown with narrow dorsocentral reddish-yellow vittae and pale lateral margins, the whole brownish or yellow pollinose, abdomen with black fasciae and median vitta. The front is broader than long, the ocellars moderately long. The wing bears brown spots as shown in the figure.

One female, Gurungwe, Southern Rhodesia, July, 1933 (A. Cuthbertson).

Homoneura liberia, new species

Figure 12

Wings with two brown fasciae and pair of spots; abdomen with black fasciae and median vitta. Length, 4 mm.

MALE.—Front broader than long, dull rusty reddish with two broad incomplete reddish-brown vittae that may appear dull brown in some views, the anterior ends triangularly broadened and almost contiguous; parafrontals brownish gray; no tiny black hairs. Occiput reddish, mostly brown on the upper half, cinereous pollinose. Cheeks yellowish, whitish pollinose. Face pale brownish, the orbits, a median vitta and the oral margin yellowish; pollen cinereous; a brown, triangular spot on the orbits opposite the antennae. Palpi brownish on apical half, reddish basally. Antennae reddish, the third segment brown except on the narrow base; arista black, rather short plumose.

Thorax rusty reddish, the pleura mostly brown in ground color; pollen moderately thick, cinereous, the mesonotum with a pair of moderately wide brown dorsocentral vittae and some brown pollen laterally behind the suture, the pleural sclerites mostly brown pollinose, but the sutures are broadly cinereous and the reddish areas bear cinereous pollen. Scutellum reddish brown, with about the apical half yellow, the pollen mostly brownish yellow. Three pairs of dorsocentrals.

Legs reddish yellow, the femora brownish red, with pale apices; the weak comb on the front femora occupying about the apical two-fifths.

Wings cinereous hyaline, with whitish reflections on the anterior two-thirds and brown markings as in figure.

Abdomen black and rusty reddish. Each segment with about the apical half and a broad median vitta black, the first wholly black. Marginals subappressed except on apical segments.

HOLOTYPE.—Male, Reppo's Town, Liberia, September (J. Bequaert).

Homoneura cuthbertsoni, new species

Figure 6

A large brownish species with grayish pollinose thorax; wings with large brown spots. Length, 5 to 5.5 mm.

MALE.—Front wider than long, brown, the anterior border, a median stripe and the orbits reddish or yellowish; parafrontals, posterior orbits, lower half of the occiput and cheeks cinereous or cinereous white pollinose; frontal stripes subshining but with yellowish-brown pollen; ocellars long; only a few tiny hairs on the parafrontals. Face brownish yellow, and grayish-yellow pollinose, the facial grooves blackish. Palpi brown. Antennae dark reddish, the third segment almost all brown; arista black, short plumose.

Thorax usually almost all brown in ground color but sometimes considerably reddish, especially on the sides of the mesonotum and along the pleural sutures; quite thickly gray pollinose, but there is a broad brownish band along the upper border of the pleura and there are four brown vittae on the mesonotum, a pair of moderately broad dorsocentrals and a sublateral pair beginning at the suture and extending to the posterior margin; in addition there is a brown stripe above the base of the wings. Three dorsocentrals.

Legs reddish yellow, the femora mostly brown or reddish, the coxae reddish, the front pair brown anteriorly. Comb on front femora fine and limited to the apical third.

Wings cinereous hyaline, with dark brown markings as shown in the figure. Squamae grayish, with pale brown border and yellowish fringe. Halteres yellow.

Abdomen black and reddish. First and second segments reddish, the second with the apical third or more black; third to fifth segments with the apical third or more and a broad median vitta black. Sixth segment usually black with small reddish basal spots laterally but the reddish may be more extensive. Genitalia reddish.

FEMALE.—Fifth and sixth abdominal segments marked similarly to the preceding segments.

TYPES.—Holotype, male, Dande River, Southern Rhodesia, July, 1933 (A. Cuthbertson). Allotype, female, Lomagundi, S. Rhodesia, May, 1931. Paratypes: three males and one female, same data as allotype; two males, Chirinda Forest, November, 1930 (A. Cuthbertson).

SAPROMYZA FALLEN

Although most of the African species of Lauxaniidae have been described in this genus it is doubtful that many of them belong here. There are before me two undescribed species from Southern Rhodesia, but I have seen no others from Africa.

Sapromyza rhodesiella, new species

Brownish red, with cinereous and brown pollen; mesonotum vittate; wings cinereous hyaline. Length, 3 mm.

MALE.—Front slightly longer than wide, dark brown with a median reddish vitta, the parafrontals thickly white pollinose. Occiput dark in ground color, brown pollinose, becoming grayish toward the narrowly white pollinose orbits. Cheeks narrow, with brownish pollen immediately below the eyes. Parafacials white pollinose; middle of the face brownish red, becoming brown laterally. Palpi brown. Antennae brown, the third segment brownish yellow, oval, the arista weakly pubescent.

Thorax apparently brownish red in ground color, densely cinereous pollinose, the mesonotum with four wide brown vittae, the median pair extending to the apex of the scutellum, the scutellum otherwise reddish yellow and with yellowish pollen. Four pairs of dorsocentrals, one in front of the suture.

Coxae yellowish; femora and anterior tibiae brown, the femora with thin cinereous pollen, the apices of all the femora, broad base of the front tibiae, the posterior four and their tarsi yellowish, the middle and hind tibiae with the apices broadly brown. the posterior pair with a sub-basal brown band; anterior tarsi reddish basally.

Wings cinereous hyaline, with luteous tinge. Squamae yellowish, with brown fringe. Halteres missing, probably yellow.

Abdomen brown above, brownish yellow below. Above there is an entire cinereous pollinose vitta and the apices of the segments are cinereous, the pale color projecting forward irregularly, particularly toward the sides of the segments. Genitalia brownish yellow and brown.

HOLOTYPE.—Male, Vumba Mountains, Southern Rhodesia, October 20, 1935.

Sapromyza vumbella, new species

Shining black and reddish yellow; wings with luteous tinge and yellowish basally. Length, 4.5 mm.

Female.—Front slightly longer than wide, shining blackish, but rather castaneous in front, especially toward the sides; ocellars of moderate length. Face, cheeks and occiput yellow, slightly shining. Palpi reddish, their tips obscurely brown. Antennae black, the arista pubescent.

Thorax shining, black, the broad sides of the mesonotum, the pleura broadly in front and behind, and the sternum, reddish or reddish yellow. Three pairs of dorsocentrals.

Legs, including the coxae, reddish yellow, the anterior femora, except the base and apex, and the anterior tarsi, except the reddish base, blackish; the anterior tibiae become brownish on the apical half.

Wings with luteous tinge, broadly reddish yellow basally. Squamae reddish yellow, with pale fringe. Halteres reddish.

Abdomen shining black, rather short and broad.

Holotype.—Female, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson).

Below is a list of the species described in *Sapromyza.*

afra Rondani, 1864, Arch. Zool. Canest., Modena, III, p. 36 (Cape).
africana Adams = *Homoneura.*
angustifrons Thomson, 1868, 'Eugenies Resa,' p. 564 (Mauritius, Cape).
argus Macquart, 1846, 'Dipt. Exot.,' Suppl. 1, p. 203 (Cape).
bilineata Speiser = *Homoneura.*
drahamensis Villeneuve, 1921, Ann. Soc. Ent. Belg., LXI, p. 160 (North Africa).
guttulata Macquart = *Homoneura.*
incisuralis Macquart, 1852, 'Dipt. Exot.,' Suppl., IV, pt. 2, p. 274 (Mauritius).
lyrica Speiser, 1910, 'Kil.-Meru Exp.,' X, p. 174 (Kilimandjaru).
maculipes Becker, 1907, Zeits. Hymen. Dipt., p. 383 (Algiers).
obliquepunctata Macquart = *Homoneura.*
oestrachion Schiner, 1868, 'Novara Reise,' Dipt., p. 278 (S. Africa).
quadrata Bezzi, 1908, Boll. Soc. Ent. Ital., XXXIX, p. 129 (Eritrea).
quadrimacula Walker, 1849, 'List. Dipt. Brit. Mus.,' IV, p. 1093 [*Helomyza*] (West Africa).
ringens Loew, 1862, Ofvers. Kongl. Vet. Akad. Forh., XIX, p. 8.
sexvittatus Curran = *Homoneura terminalis* Loew.
terminalis Loew = *Homoneura.*
tethis Speiser, 1910, 'Kil. Meru. Exp.,' X, p. 173 (Kilimandjaru).
trinotata Loew = *Homoneura.*

CELYPHUS DALMAN

This genus is apparently not known from Africa, the species described belonging to the following genus.

ACELYPHUS MALLOCH

I have seen one species belonging to this genus.

Acelyphus africanus Walker

Celyphus africanus Walker, 1849, 'List Dipt. Brit. Mus.,' IV, p. 1139.
Celyphus galamensis Bigot, 1878, Ann. Soc. Ent. France, Bulletin, p. xlix.

A series of specimens collected by Dr. F. Zumpt, on Mount Cameroon in 1935.

The color varies from brassy green to blue. There can be little doubt about Bigot's species being the same as *africanus*.

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MONGOLIAN MAMMAL NAMES

By George Gaylord Simpson

The recent mammalian faunas of Mongolia and of other parts of Asia inhabited by Mongols are of extraordinary interest for their richness, their economic importance, their inclusion of notable game animals, their influence on history, and their affinities with the mammals of Europe on one side and of North America on the other. They are now being very actively studied by the Russians and also by other Europeans and by Americans.[1] Because of this interest and as an adjunct to such studies it seems worthwhile to present a list of Mongolian literary and colloquial names of mammals.

The value of recording local names for mammals is generally recognized although few accurate and adequate lists are available. In the case of many obscure dialects, the interest is largely ethnological or linguistic, but Mongolian is an old literary language, one of great historical importance, and one spoken today by millions of people scattered over the greater part of Asia, so that its animal names are of more general value. The traveler, hunter, and collector find it helpful or indeed necessary to know the native names of the animals that they observe or that they are seeking. The zoölogist is sure to find them interesting and probably will find them useful. They are important in gathering information on life habits and distribution, and knowledge of them may be essential in following accounts of travelers and students. Where no vernacular name exists in a European language, it is convenient to know and to adopt the Asiatic names. From Mongolian and allied languages we have already taken several vernacular names such as "kulan" and "dschiggetai" or "jiggetai."[2] The Russians use more Asiatic names than we do and probably others of these will become internationalized. Within reasonable limits this is highly desirable. It is, for instance, surely better to call the central Asiatic mammal "allactaga" or "alaktaga" than "leaping hare" or leaping mouse." It is neither a hare nor a mouse, it is only one of many leaping rodents, and some quite unlike the alaktaga are already called by those English names.

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[1] For instance by G. M. Allen who has completed a two-volume report on the mammals of China and Mongolia soon to be published by this Museum.

[2] A better spelling would be "chikhitei," see p. 20.

The autochthonous vernacular names are also a fruitful source for technical names, highly appropriate because of their geographic association and especially useful as it becomes increasingly difficult to find unpreoccupied Greek and Latin combinations. Several scientific names are already based on Mongolian: the generic names *Ochotona* and *Allactaga* and the specific name *Lepus tolai*, for instance, are derived from that language. Such "barbarous" names are deprecated by a few purists but all now admit them to be valid and they are being used increasingly. As a personal opinion, on grounds of mnemonics, of freedom from probable preoccupation, and of appropriateness, I would often prefer a scientific name for a Mongolian animal derived from a Mongolian root to another permutation of the shopworn Greek and Latin roots.

Aside from these and various lesser points in which a list of Asiatic mammal names may be of interest and of use zoölogically such a list may also have considerable interest to students of history, literature, ethnography, linguistics, religion,[1] and other subjects. The viewpoint in this paper is zoölogical but these other purposes may also be served to some extent.

In the following lists three forms of the Mongolian words are given in most cases. The name in ordinary Roman type is a transliteration of the literary Mongolian form. As this is not intended to be pronounced, no special explanation of the system used is necessary here. The names in Italics are approximate phonetic representations of colloquial forms. With the following exceptions, letters are to be pronounced as in English:

Simple vowels have about the continental values as in Spanish or Italian. *ŭ* and *ŏ* have nearly the German values, or those of French *u* and *oe*. These two letters and particularly *o* and *u* are, however, less sharply distinguished than is usual in European languages.[2] Long vowels are here represented by doubling the letter. The distinction between long and short vowels is not at all as in English in which most so-called long vowels are diphthongs quite unlike the short vowels. In Mongolian the long vowels are a literal prolongation of the short, or a duplication without a pause. Long vowels and the vowel of the first syllable are pronounced clearly, but others (short vowels after the first syllable) are generally reduced in length and in value, tending to a neutral sound, much as do the vowels in the English articles "the," "a," etc., when these are not stressed. Such reduced vowels may nearly or quite disappear in pronunciation.

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[1] Because in this instance the dominant religion, lamaistic Buddhism, is permeated with animal symbolism and mythology.

[2] They are not distinguished at all in Mongolian writing.

Kh is an open guttural intermediate between *k* and *h*, approximately Spanish *j* or German posterior *ch*.

S is always voiceless, as in "hiss," not as in "his."

G is always hard, as in "get," not as in "gem."

J is English *j* as in "jet."

Sh is English *sh* as in "shut."

Ch is English *ch* as in "chat."

Ng is English *ng* as in "singer," not as in "finger." *Ngg* is like *ng* in "finger."

In the Khalkha dialect the voicing tends to be reduced or lost in some nominally voiced consonants such as *g* or *d*, but this is a somewhat complex phenomenon not necessary for an approximate pronunciation and not taken into account in these transcriptions. In this dialect *b* also tends to have incomplete closure, approaching English *w*, and this phenomenon also sometimes affects other consonants.

Final consonants, especially *n*, and sometimes whole final syllables are often reduced and sometimes lost. In the transcriptions letters enclosed in parentheses may be pronounced or not at will. In rapid colloquial speech they are usually not pronounced. Final *n*, of very frequent occurrence in the language, may also take on the sound of *ng* in "sing," or may become a slight terminal nasalization of the preceding vowel. Thus *arsala(n)*, "lion," may be pronounced *arsalan*, *arsalang*, *arsalaã* (in which *ã* is a reduced nasal vowel), or *arsala*, and in all these cases the second and third *a*'s are reduced and indistinct, while the first is clearly pronounced.

The stress accent is on the first syllable, whether its vowel is long or short.

Of course these simple phonetic indications do not suffice for pronouncing exactly like native speakers, but they will produce a recognizable approximation.

The third form given for most Mongolian names is the written form in native script,[1] referred to in the printed text by numbers in parentheses. It is not anticipated that mammalogists or travelers will wish to learn to read these or will have occasion to use the written forms, but it seems desirable to give them. There is no standard way of representing Mongolian in Latin letters. The pronunciation may vary markedly in the different dialects and even with different speakers of the same dialect. The European ear generally fails to hear the Mongolian pronunciation exactly and each traveler, according to his nationality and personal idiosyncrasies, also has his own way of recording what he thinks he hears. The result is that hardly any two persons latinize the same Mongol words in the same way and often their representations are almost unrecognizable. In view of these facts the only way to identify and record a Mongolian word with no possibility of mistake is to give the written form in the literary language, as well as the colloquial spoken form. It is unfortunate that this has not hitherto been done.[1]

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[1] It will be noticed that the Mongolian script has nothing in common with Chinese. It is a true alphabet, derived from an ancient Semitic alphabet through the Sogdians and Uigurs. Although with certain drawbacks, it is relatively simple and easy to learn and is better adapted to the Mongolian language than are European alphabets. For historical reasons, the spelling of a word no longer corresponds in all cases with its pronunciation (a difficulty about equally present in English), and the literary language also differs to some extent from the colloquial dialects in grammar and vocabulary, but the divergences are not unduly great and the literary language has the great advantage of being more or less standard for all Mongols despite their numerous different spoken dialects.

Unless otherwise specified, the spoken forms given are Khalkha Mongolian, the language of the politically and historically most important group of Mongols, approximately that of the present Mongolian Republic (or "Outer Mongolia"). The language as a whole has innumerable dialects, some so distinct that they are often classed as different languages. In most cases mammal names in other dialects are recognizable variants of the literary and of the Khalkha forms and I have not attempted to trace names through all the various dialects. In a few cases it has, however, seemed useful to give "Kalmuk" or Buryat names. The so-called Kalmuks (or Ölöts) are the western Mongols, now scattered from eastern Europe across Turkestan into western China and the Buryats are the Mongols of Siberia. Each of these groups includes a variety of dialects, which need no specification for present purposes. Khalkha is a single dialect although even it has slightly divergent subdialects.

The Mongolian vocabulary relating to mammals is very rich. From prehistoric times hunting has been a favorite occupation of the Mongols and their outdoor lives and nomadic habits have brought them into close contact with the fauna of the areas they inhabit. Speakers of various Mongolian dialects are now scattered from Manchuria to eastern Europe and from Siberia to Tibet, so that even now they are in contact with practically the whole Asiatic fauna except for animals confined to southernmost Asia. Their former extension was still greater and they retain vivid memories of it in their folklore and popular literature. More-over, and particularly for the south Asiatic mammals with which they have otherwise had little contact, their religious literature, mostly derived from Tibet or ultimately from India, and some of their popular literature from the same sources abound in stories of animals. The Panchatantra, for instance, a collection of animal fables of Indian origin still highly popular in Mongolia, frequently mentions lions, monkeys, elephants, and other animals that do not occur in Mongolia proper. Names for all these animals are now an integral part of the everyday Mongolian vocabulary although they cannot have occurred in proto-Mongolian. These names for exotic animals are, of course, of less interest from the point of view of the present paper and no attempt is made to list them exhaustively, but the most common and important of them are given.

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[1] These remarks apply with even greater force to geographic names. In many cases it is practically impossible to tell what Mongolian words are really intended by the latinized forms that are becoming standard on our maps of Mongolia. On many of the best Chinese maps it is customary to give the written Chinese names as well as latinized equivalents, and it would be most desirable to extend this practice to Mongolia.

All the common and striking central Asiatic mammals have Mongolian names generally consisting of a single root. As in other languages, differentiation between closely similar forms or names for relatively unfamiliar animals are often formed by adding a descriptive or qualifying word to a common root.[1] The language is also rich in descriptive, fanciful, or poetic names and paraphrases that more or less duplicate the ordinary vocabulary of animals. Thus "sheep's assassin" means wolf and "the eary one" means the wild ass, although there are ordinary simple roots for wolf and for wild ass. Except for a few special cases, these fanciful duplicating names are not included in the following lists. As would be expected, the vocabulary for domestic animals, and especially for the horse and horsemanship, is extraordinarily large. An exhaustive study of these terms would be of ethnological value, but in this paper only the more important roots of more directly zoölogical interest are included.

Male, female, and gelded animals are distinguished in several ways. Frequently there are different words for the first two or for all three, analogous to "bull," "cow," and "steer"; these are listed in the following vocabulary. More rarely a sex name for one animal is placed before the name of another to differentiate sex in the latter, exactly as we say "bull elephant" and "cow elephant." If sex must be specified and there are no separate words, however, the usual practice is to place the word ere, *ere*, (1), "male," or eme, *eme*, (2), "female," before the name of the animal.[1]

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[1] Sometimes this is by simple juxtaposition of two roots and sometimes by the use of suffixes. The most common suffixes i [illegible] with the sense of "with," [illegible] takes care of, or has to do with." Example [illegible] one" (an epithet of the kulan); *khoni(n)*, "sheep," *nokhai*, "dog," *khonichi nokhai*, "sheep dog."

Mongolian adjectives and verbs do not indicate number and although number can be indicated in nouns this is not usually done. The simple root form is used for both singular and plural unless it is absolutely necessary to specify the plural and this is not clear from the context. In usual speech *mori(n)* means "horse" or "horses." If it is important to indicate more than one, they say "two horse," "three horse," "many horse," "herd of horse," etc., and the use of an actual plural is only a rare last resort, except for pronouns and some special instances among nouns not pertinent here. Zoölogists thus have no occasion to learn the Mongolian plurals, which are somewhat irregular and difficult, and these are not given here.

Besides specifying sex and, in domestic animals, geldings, Mongolian has for some animals special words for the young, analogous to "colt" or "cub." In a few cases there are even separate words for animals in their first, second, third, etc., years. These names with implication of age are not exhaustively listed below, but the more important are given.

In Mongolian, as in other languages, the nomenclature of animals does not correspond with scientific taxonomy. In some cases the Mongolian name is so broad or so ambiguous from a taxonomic point of view that it would be merely misleading to equate it with a definite species or genus. In other instances such equations can be made with reasonable accuracy and I have attempted to do this wherever possible. Even in such cases, however, it must not be assumed, unless evident, that the equivalence is exact. *Tarbagan*, for instance, is reasonably defined as *Marmota bobak*, because that is the species most familiar to the greater number of Mongols and generally called *tarbagan*, but the word would be and in fact is also applied to other species of *Marmota* or even of similar allied genera with which a Mongol comes in contact. On the other hand the Mongols do sometimes distinguish between species of one genus, as *Vulpes vulpes* and *Vulpes corsac* for which they have different names As in English, the Mongolian word for "mouse" (*khulagana*) includes a multitude of small rodents of various genera and families. Many accounts in which some local names are given state or imply that the local name designates only one local species, but this is seldom true, especially in dealing with a widespread language like Mongolian. The way in which we use English vernacular names like "mouse," "fox," "deer," and so on is rather closely analogous to the way in which the Mongols use their vernacular names and may serve as a criterion as to how seriously to take their equation with scientific names.

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[1] Some grammarians say that there are suffixes placed after adjectives of color that show that the animal is female when its name is qualified by one of these adjectives. If not an error, however, this at least is neither in common use nor generally understood among Mongols today, and it can be disregarded for any practical purpose. Mongolian is without suffixes of sex analogous to [illegible] in [illegible] in Spanish. The nearest approach to this is the very rare occurrence of such related words as *gunang* and *gunajing* which apply, respectively, to male and female 3-year old domestic cattle.

In addition to this degree of confusion or of vagueness in the language itself, the sources of information are not free of error. Zoölogists who have worked on Mongolian mammals are generally very deficient as linguists, the linguists are almost all without any definite knowledge of zoölogy, and most travelers are neither zoölogists nor linguists.[1] The present list could be made only by the very laborious effort of gathering information from dozens of different sources and collating it as well as possible. It still has recognized ambiguities and doubtless also has unrecognized errors. It is presented as an incomplete and imperfect first attempt in a remarkably difficult field, with the hope that later work will extend and perfect it. The most important zoölogical and linguistic works used are listed at the end of the paper. Various others only confirmed the information from these and so are not cited. Common names of generally accepted meaning require no citation of authority, but in cases of unusual or doubtful words such citations are generally made. No two authors use the same system of transliteration or of phonetic transcription, so utter confusion was avoided only by giving all words in the system used here, regardless of how they were written in the source cited. In addition to these works, some dozens of books of travel in central Asia have been examined but with the noteworthy exception of Przhevalskiy few of these give any Mongolian mammal names not available from other and linguistically more reliable sources.

WRITTEN MONGOLIAN NAMES

The numbers in parentheses throughout the following text refer to the correspondingly numbered Mongolian words here given.

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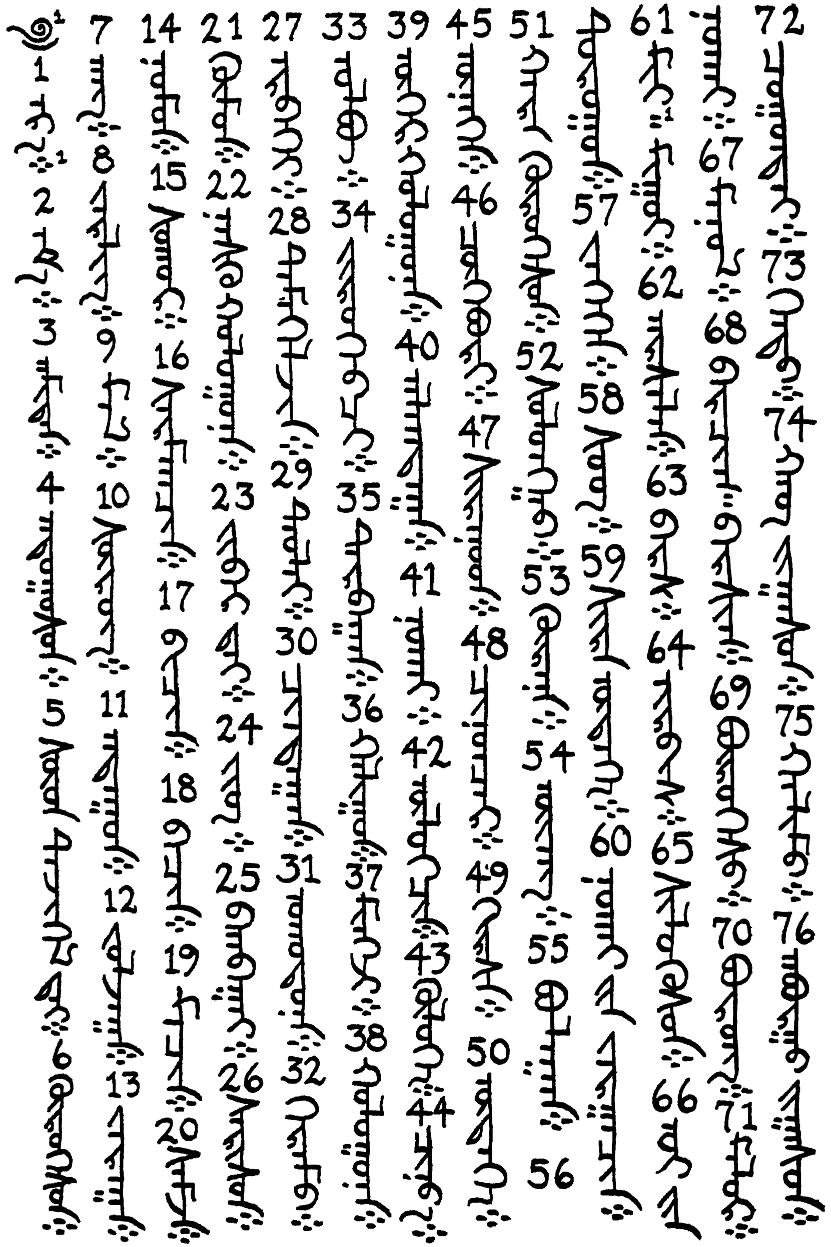
[1] A single example will suffice to show the difficulty of gleaning reliable information even from the few exemplary travelers who do give any "native" names. Perry-Ayscough (in "With the Russians in Mongolia," London, 1914) says, "On two occasions we saw wolves. The first time the wolf was of the species called 'Chani,' and the next time it was an 'Unik.'" Evidently they saw one wolf, *chono*, and one fox, *ünege*. Here the words are at least recognizable. Often they are not.



[1] *These are punctuation marks.*

77 [illegible]

78 [illegible]

79 [illegible]

80 [illegible]

81 [illegible]

82 [illegible]

83 [illegible]

84 [illegible]

85 [illegible]

86 [illegible]

87 [illegible]

88 [illegible]

89 [illegible]

90 [illegible]

91 [illegible]

92 [illegible]

93 [illegible]

94 [illegible]

95 [illegible]

96 [illegible]

97 [illegible]

98 [illegible]

99 [illegible]

100 [illegible]

101 [illegible]

102 [illegible]

103 [illegible]

104 [illegible]

105 [illegible]

106 [illegible]

107 [illegible]

108 [illegible]

109 [illegible]

110 [illegible]

111 [illegible]

112 [illegible]

113 [illegible]

114 [illegible]

115 [illegible]

116 [illegible]

117 [illegible]

118 [illegible]

119 [illegible]

120 [illegible]

121 [illegible]

122 [illegible]

123 [illegible]

124 [illegible]

125 [illegible]

126 [illegible]

127 [illegible]

128 [illegible]

129 [illegible]

130 [illegible]

131 [illegible]

132 [illegible]

133 [illegible]

134 [illegible]

135 [illegible]

136 [illegible]

137 [illegible]

138 [illegible]

139 [illegible]

140 [illegible]

141 [illegible]

142 [illegible]

143 [illegible]

144 [illegible]

145 [illegible]

146 [illegible]

147 [illegible]

148 [illegible]

GENERAL

amitan, *am(i)ta(n)*, (3). Living thing, organic creation in general.

adugusun, *aduusa(n)*, (4). Animal. This common word is recognizable in most dialects but becomes *aase* in Kansu (de Smedt and Mostaert).

süün tezigel-tei, *süün tejeeltei*, (5). Mammal. Literally "with milky food," a descriptive phrase adopted to translate "mammal" into Mongolian, rather than a purely native conception of a natural group.

görögesön, *göröös(ön)*, (6). Beast, quadruped, wild animal.

Used alone, this word often means antelope.[1] It is often used with qualifiers in descriptive expressions for various animals, for example *khara göröös(ön)*, "black beast," for "bear."

ang, *ang*, (7). Game, game animals, objects of the chase. Occasionally used to distinguish wild from domestic animals, as in *ang gakhai*, "game pig," i.e., "wild boar."

zerlik, *dzerlik*, (8). Wild, used in much the same way as in English. *Dzerlik gakhai*, "wild boar."

mal, *mal*, (9). Horned cattle, cattle in general, domestic animals.

sürüg, *süreg*, (10). Flock, troop, band (of anything, including animals, and among the latter particularly of sheep and goats).

adagun, *aduu(n)*, (11). Herd, usually of horses but occasionally of cattle or sheep. Also by extension an animal such as enters into such herds or flocks.

zulzaga, *dzuldzaga*, (12). Young, the young of a mammal or bird, often used (after the name of the animal concerned) to designate the young when no specific word is available, e.g., *gakhai dzuldzaga*, "young pig."

Some other terms, as of sex or age, that can be applied to various different animals are given below in connection with the animals primarily concerned (for example *ölögchin*, "bitch of domestic dog," also used to designate the female of other carnivores).

INSECTIVORA

zaraga, *dzaraa*, (13). Hedgehog. *Erinaceus* and *Hemiechinus* spp.

nomon, *nomon* or *nomin*, (14). Mole, talpids in general. Usually as *sokhor nomin*. [Sokor, *sokhor*, (15), "blind."] Also *mana sokhor*, which is likewise applied to shrews. Ognev gives *adda* for *Talpa altaica* in Buryat, but I do not find this in dictionaries, where Podgorbunskiy gives *udun khulugana* as the Buryat for mole or shrew (which he specifies as "*Crossopus fodiens* Pall.").[1]

---

[1] To such an extent that some students (e.g., Poppe) give only this meaning for the word. This is a popular usage, but the word originally meant "beast" and is still so used. Nor is it the specific word for "antelope," see below. A curiously analogous shift of meaning has occurred in English in which the word "deer," originally any animal (cf. German "Tier"), has come to mean only one kind of animal and that a European analogue of the Mongolian antelope.

Pallas gave "saartucholgonà" (*saartukholgonaa*) as a Kalmuk name for *Desmana moschata.* The second part of this is probably a variant of *khulagana,* "mouse," but I have not found the word, or words, elsewhere except as a quotation from Pallas and cannot further elucidate its etymology. Podgorbunskiy gives *kuduri* as a Buryat name for this animal. This is an obvious transfer of meaning from the musk-deer, küderi, *khüdere,* see below under Cervidae.

PRIMATES

sarmakcin, *sarmakchi(n),* (16). Monkey. This is the common word for monkeys, very familiar to Mongols in tales of southern origin if not in person. The following two words seem to be simple synonyms without conscious implication of zoölogical differences.

bicin, *bichi(n),* (17), or becin, *bechi(n),* (18). Monkey.

mecin, *mechi(n),* or *michi(n),* (19). Monkey. (A variant of the preceding word.)

samza, (20). Monkey. (A literary word.)

kümün, *khun,* (21). Man, mankind. There is, of course, an enormous vocabulary relative to human beings but this, meaning man in the general sense, is the only word pertinent here.

CHIROPTERA

As in some European languages, a bat may be called "flying mouse," neskü kuluguna, *niskhu khulagana,* (22) or "winged mouse," zibertei kuluguna, *jibertei khulagana,* (23). Kovalevskiy and Golstunskiy give a literary form zib (24), doubtless related to ziber, *jiber,* wing, but I do not find this in colloquial use.

bakbagai, (25). Bat in literary usage, as agreed by all authorities (e.g., Kovalevskiy, Golstunskiy, Bimbaev), but it does not appear now to have this sense in colloquial usage unless qualified by an adjective. Colloquial forms of bakbagai, alone, (*baabagai,* etc.) have come to mean "bear," not "bat" (Burdukov, Poppe, and other reliable authorities) An exception is Kalmuk in which *bavukha,* probably cognate with bakbagai, still means "bat" (Mayorov). But *sarisan baabagai* (Burdukov) or *sarison babgay* (Bimbaev) means "bat" in Kahlkha. The first word in this expression is the literary sarisun, (26), and means "leather" or

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[1] *Ada* means "devil" or "vagabond," which perhaps has no connection with Ognev's *adda.*

"membrane," clearly in reference to the wings. The Ordoss form is *sarisu bagwaakhaa.* The Kansu Mongols use *sorodze bierdu* and the Shirongol *surusu bilduu* (de Smedt and Mostaert), in which the first word is cognate with sarisun but the second is of unknown origin or separate significance. Bimbaev also gives *sarison erbekhiy* as Khalkha for "bat." The second word I take to be erbekei, (27), in which case the phrase means "leathery or membranous butterfly."

ümeshi. Given by Podgorbunskiy as Khalkha for "bat," with the Buryat variants *rümshe, ürmüshe,* and *khermeshi.*[1]

temegelzin, (28). Literary word for "bat" (Kovalevskiy, Golstunskiy). The corresponding Khalkha would probably be *temeelji(n)* but I have not confirmed its current use.

LAGOMORPHA

taulai, *tuulai,* (29). Hare, rabbit. Especially *Lepus tolai,* the specific name of which represents this Mongolian word, but also leporids generally.

cindagan, *chindaga(n),* (30). Arctic hare, *Lepus variabilis.*

ogotona, *ogotona,* (31). Picas or coneys, *Ochotona* spp., the generic name of which represents this Mongolian word. It is commonly stated that the name means "short-tailed," but this is questionable. One of several Mongolian words for "short" is *okhotor* (or *ogotor*), but it is possible that an accidental punning resemblance has suggested the etymology. The Mongolian word for "tail" is *süül,* which obviously is not present in *ogotona,* nor can I find that the latter is ever used adjectivally to mean "short-tailed," but only that it is the explicit name for these animals. Kovalevskiy defines ogotona as "*Sciurus striatus,*" but this is simply an error corrected by Golstunskiy and others.

Przhevalskiy, in Büchner, gives *ogotona* as Mongolian for "*Lagomys dauricus*" and for other species of "*Lagomys*" gives other names, as follows:

Lagomys melanostomus: ama-tsagan. [*Ama* means "mouth, gate, household," but perhaps another word is intended; *tsagan* means white; "white mouth" would ordinarily be *tsagan ama.*]

Lagomys roylei: ama-tsagan-khulugono [the last element clearly for *khulagana,* "mouse"].

Lagomys erythrotis: sarik-tiki. [Not identified; there is probably some error as the syllable *ti* does not occur in ordinary Mongolian, being usually represented by ci, *chi.*][1]

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[1] I have not found a literary form of this word. It is somewhat far-fetched but not impossible that it is related to ürüme, meaning "scum on milk or cream"—ürüme kulagaiyci is "dragon fly," cf. erbekei, "butterfly," applied to the bat. *khermeshi,* on the other hand, suggests kereme, "squirrel."

It seems doubtful whether these are names, properly speaking, rather than descriptive phrases, and it is highly unlikely that they are really used to distinguish the species, as listed. In any case *ogotona* is applied to any species of the genus and not exclusively to *Ochotona daurica.*

RODENTIA

Sciuridae

keremu, *khereme(n)*, (32). Squirrels in general.

olbo, *olbi*, (33). Flying squirrels, *Petaurista* spp.

zirukebchi, (34). Striped squirrel, *Eutamias asiaticus.*

The colloquial Buryat name *jir-khe* (Przhevalskiy in Büchner, Podgorbunskiy, the latter also giving as variants in Buryat dialects *dirke, zhirkhi, zhirki*) clearly is related to, but is not the whole of, the literary name. These words suggest ziruke, *jir(u)khe*, which means heart, strength, courage, etc., and to which zirukebchi is probably related.

dzumburaa. Spermophiles, *Citellus* spp.

tarbagan, *tarbaga(n)*, (35). Marmots, *Marmota bobak*, etc.

mondul. Young marmot (in its first year).

Castoridae

kaligun, *khaliuun*, (36). Beaver, otter. See this and the following word on p. 17.

mingzi, *minji*, (37). Beaver, otter.

Muridae (*sensu lato*)

kuluguna, *khulagana*, (38). Mouse, general name for murids in a broad sense. As in most languages, a single word is used to cover the house mouse and almost all small animals that are at all mouse-like, even some that are not rodents (cf. *jibertei khulagana* in Mongolian or "Fledermaus" in German for "bat"). Different sorts of mouse-like mammals are distinguished, if at all, by qualifiers placed before *khulagana*, in a way capricious, descriptive, or merely personal, seldom involving any real and rational popular classification and not, on present data, capable of equation with a zoölogical system. Examples (from Kovalevskiy), are mogaiichi kuluguna, "snake mouse,"[2] müsüchi kuluguna,

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[1] The original might be a dialect variant of (written) sarig(u) ciki, "crooked ear," but this is merely a guess with no real value.

[2] Mogaii = snake. On the sense of -chi in this and numerous other qualifiers see p. 5.

"ice mouse," mürgülchi kuluguna, "nodding mouse," usuchi kuluguna, "water mouse," and others. Only the next expression in this list seems sufficiently common and explicit to warrant further notice.

üker kuluguna, *ükher khulagana,* (39). Rat. Literally "cattle mouse," applied to the common rat and to undistinguished relatives by both Khalkhas and Buryats. Bimbaev gives "*chonon Kholgono,*" "wolf mouse," for rat.

Podgorbunskiy gives *khara khu* for *Mus decumanus* in a Buryat dialect (in addition to variants of *khulagana* for "mouse" and *ükher khulagana* for "rat" in most Buryat dialects). *Khara* means "black" and *khu,* if not a misprint, may be a highly reduced form of *khulagana.* Przhevalskiy, in Büchner, gives *shishi* for *Mus cherrieri.*[1]

Przhevalskiy, in Büchner, also gives *nomin-sokhor* for *Siphneus* [= *Myotalpa*] *fontanieri.* As noted above *nomin-sokhor* is a common name for moles or mole-like animals and this is evidently a case of mistaken identity and not of an explicit name for this animal. He also gives *bardaa* for *Gerbillus* [or *Rhombomys*] *opimus.*[2]

DIPODIDAE

alakdaga,[3] *alakdaga,* (40). Allactagas or so-called jumping mice, *Allactaga* spp., the generic name of which is this Mongolian word, and dipodids in general. Following Pallas, it is almost always stated that this word means "variegated [piebald] colt." It is true that it is nearly homophonous with *alag daaga*(*n*), which does have that meaning, and the etymology may prove to be correct, but there are several facts that cast doubt on this. In correct Mongolian two roots, such as *alag* and *daaga,* are not combined into one word, but *alakdaga* is written as one word.[4] The last two syllables, written and pronounced -daga, are not really the same as the word for colt, written dagagan and pronounced *daaga*(*n*).[5] It would also be strange, even though not impossible, that the special word *daaga*(*n*), meaning a colt in its second year, was used instead of the more common word *unaga*(*n*), or some other. Finally, this would be a peculiar designation to apply to an animal that is not piebald and does not at all resemble a colt. It is thus conceivable that the supposed derivation of *alakdaga* is amateur etymology mistaking a punning resemblance for a historical derivation.[1]

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[1] In the literary language, at least, shishi means a kind of grain (cereal), the Chinese kaoliang.

[2] Probably reliable at least in a general way, but I do not find it elsewhere and the fact that *bardaa* may also mean "abundant" (although not the usual word with that meaning) suggests a possibility that Przhevalskiy misunderstood his informant.

[3] Usually transliterated alagdaga or alagdaaga. The usual pronunciation is apparently *alakdaga* or *alaktaga*, so there is no reason to insist on a change in our customary spelling allactaga.

[4] By Europeans it is sometimes written as two words or with a hyphen, but as far as I have found the Mongols themselves write and use it as a single word.

[5] Here, again, Europeans sometimes write *alagdaaga* or a similar form, but evidently because of belief in this etymology, whether true or false. Nor is it impossible for dagagan, *daaga*(*n*), to have become reduced to daga, *daga*, in Mongolian, but this would require more evidence than has been adduced.

The Kalmuks call these animals *yalma* or *yalmn,* a loan-word absent from other Mongolian dialects.

CARNIVORA FISSIPEDIA

Canidae

nokai, *nokhoi,* (41). Domestic dogs in general.

ölögcin, *ölögchin,* (42). Bitch (of domestic dog). Also called simply *eme nokhoi,* "female dog." *Ölögchin* is also prefixed to the names of other carnivores to designate the female.

gölöge, *gölgö,* (43). Puppy (of domestic dog), or young of various animals.

cinoa, *chono,* (44). Wolf, *Canis Lupus.* This common word is almost universal in the Mongolian dialects, with slight phonetic variations. The pronunciation of the first vowel as *o* is not ancient but is now general (In Khubilai Khan's day the word was *chinoo*). "Female wolf" is *ölögchin chono,* literally "bitch wolf." Przhevalskiy says that the Tibetan wolf "is most probably identical with the species we heard the Mongols in Kansu call *tsobr.*" No word like *tsobr* is given by de Smedt and Mostaert in their exhaustive work on the Mongolian spoken in Kansu, but they give the figurative name *dziuuranggee* (and not any form of *chono*) as Kansu Mongol for "wolf." This comes from the root *dziuu-* (literary zagu-, Khalkha *dzuu-*) "bite," and it is possible that Przhevalskiy's "*tsobr*" is another derivative of this root.[2]

ünegen, *ünege(n),* (45). Fox, *Vulpes vulpes,* and used with qualifiers for other fox-like animals.

tsükebüri, (46). Jackal, *Thos aureus.* This literary word probably corresponds with the Buryat spoken word given by Podgorbunskiy as *suubri* and defined as *Cuon alpinus,* and it is not inherently improbable that the same name would be applied to these two animals by Mongols familiar only with the latter at first-hand. Burdukov gives *doobori* for "jackal," and this might be cognate with tsükebüri. Mayorov gives *shahl chon* as the Kalmuk name of the jackal, in which *chon* is "wolf" (*chono* in Khalkha) and I take *shahl* to be a borrowed form of the Persian word from which the name of this animal in most European languages, including English, has been derived (Mayorov intends the second *h* in *shahl* to be pronounced as an open guttural). Bimbaev calls the jackal *shara nyudun chono,* literally "yellow-eye wolf," although Burdukov says that *shara nüde(n)* (the same words as Bimbaev's *shara nyudun*) is the hyaena. Here, again, it is unlikely that the Khalkhas or other eastern Mongols would distinguish clearly between somewhat similar animals not very familiar to them. Kovalevskiy also gives for "jackal" the literary words siranut, (47), and cinontsar, (48). Very commonly (e.g., in the Bird ms. of the Panchatantra, published by Vladimirtsov) where "jackal" occurs in tales of southern origin the Mongols substitute for it the more familiar fox.

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[1] The error, if it is one, could be made by the Mongols as well as by Europeans. Approximation of originally distinct words because of false popular etymology is a common linguistic phenomenon. It should be added that Vladimirtsov, perhaps the best linguistic authority, equates *alakdaga* with *alag-daaga(n)* and even writes it as a compound word and with the third vowel long. This is strong evidence against my tentative suggestion, but Vladimirtsov does not give his reasons or authority nor does he consider the manifest difficulties.

[2] Gilmour states that in his day (some fifty years ago) the Mongols superstitiously refrained from pronouncing the correct word for "wolf" (i.e., *chono*) but called wolves "dogs," short for "wild dogs." Later travelers do not seem to have noticed this unless the loss of the word *chono* in Kansu has this cause. On the other hand, some students of Marco Polo find in an obscure passage evidence that in his day instead of calling wolves "dogs" the Mongols called their hunting dogs "wolves"—this, however, is most uncertain and I think it probably a wrong reading of Polo's text. Modern Mongols sometimes call dogs *chonok* which they relate to *chono* by popular etymology, but in fact *chonok* has no connection with *chono* and is a corruption of the Tibetan phrase for "black dog."

kirsa, *khiarsa,* (49). The steppe-fox or corsac, *Alopex corsac.* "Corsac" is a cognate eastern Turkish name.

URSIDAE

bakbagai, *baabagai,* (25). This word is in wide use for "bear" in general or as an object of the chase, although, as noted above, its literary dictionary meaning is usually given as "bat."[1]

ütege, (50). This is the classic literary word for "bear," used with various qualifiers for various sorts of bears not very exactly identifiable zoologically.

kara görögesön, *khara göröös(ȫn),* (51). Literally "black beast." A colloquial expression for "bear."

Przhevalskiy speaks of a semi-fabulous "kung-guressu," *khūn göröösȫ* in the Khalka transcription used here, literally "man-beast" the description of which suggests a bear although the natives insisted that it was not that animal. A skin shown to him as of the man-beast was, however, a bearskin. The argument appears to be settled by the observation of de Smedt and Mostaert that *"k'un k'uorose,"* which is exactly equivalent to Khalkha *khün gȫröösö,* is the Kansu Mongol ("Monguor") name for the Tibetan bear. They also give *nokhuee k'uorose,* which would be *nokhoi göröösö* in Khalka, i.e., "dog-beast," for the black bear in the Kansu dialect. Ognev gives *tinggeri-nakhoi* for *Ursus pruinosus* in the Tsaidam dialect. This is obviously a variant of *tenggri nokhoi*, "heaven-dog" and comparable to the Kansu "dog-beast." Ognev gives *kholodaa*, a word that I do not identify in other dialects, as the Nan-Shan name for this animal and Mayorov gives *ayu* as Kalmuk for "bear."

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[1] Vladimirtsov gives babagai, *bawagai, baabga,* etc., as modern words for "bear." He says that babagai is a modern written form not present in older writing or in the literary language. He does not mention the literary word bakbagai. Difficult as it is to explain the shift in meaning, it nevertheless seems to me certain that bakbagai and babagai are the same word, the latter merely a modern variant in which the k, now usually silent, has been dropped.

MUSTELIDAE

solonggo, *solonggo*, (52). *Mustela alpinus*, and various similar species. Called *Kholunggo* by the Buryats.

kürene, *khürene*, (53). *Putorius* spp. and probably several other mustelids, polecats. Burdukov gives *ümkhii khürene.*

üyeng, *üyeng*, etc., (54). The ermine, *Mustela erminea.*

This word appears in a confusing variety of phonetic guises, *ügün*, *üin*, *yuyn*, etc. *Ugyun*, given by Ognev for *Mustela nivalis*, appears to be one of these variants. The animal is also called descriptively "white squirrel," *tsagan khereme.*

bulagan, *bulaga(n)*, (55). The sable, *Martes zibellina.*

dorogon, *dor(o)go(n)*, (56). Badger, *Meles meles* and allies.

zegegen, *dzeege(n)* or *dzeeke(n)*, (57). Wolverine, *Gulo gulo.*

sub, *sub*, (58). Otter, *Lutra lutra.* See also the following two words, with the second of which it is sometimes combined as *sub khaliuun.*

mingzi, or minzi, *minji*, (37). Otter, beaver. See the next word.

kaligun, *khaliuu(n)*, (36). Otter, beaver. This and the preceding word apply to both of these unrelated but in some respects similar animals. Burdukov gives *khaliuu(n)*, *temeen khaliuu(n)*, and *minji* for "otter (beaver)" and for otter alone gives *sub-khaliuun* [*temeen* = camel; for *sub* see above]. Podgorbunskiy gives *khaluun* (Buryat) for the "American beaver" and *menzhin* (Buryat) or *mizhi* (Khalkha) for the "Kamchatka beaver," probably intending the otter. For "otter (*Lutra vulgaris*)" he gives *khaluun* (Buryat) and *khaluu* (Khalkha). Golstunskiy gives literary forms minzi for beaver and mingzi kaligu for "Kamchatka beaver" or sea otter. Mayorov gives *suv* and *booltsn* as the Kalmuk for "otter." Bimbaev (Khalkha colloquial) gives *minji* for "beaver" and *khalyu* for "otter."[1]

HYAENIDAE

The eastern Mongols do not appear to have a proper name for the hyaena, which does not occur in their homeland. Ognev gives *dom* as its Kalmuk name. Burdukov gives *shara nüde(n)*, literally "yellow eyes," as its Khalkha designation (see "jackal," above). Kovalevskiy gives the literary descriptive expressions sira ütege, (59), literally "yellow bear," and nokai-iin zargacin, (60), literally "dog's butcher."

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[1] All these are, of course, in Russian and the words used are bobr = beaver and vidra = otter Some of the ambiguity may be Russian rather than Mongolian.

FELIDAE

mii, migui, *mii* (61). Domestic cat. Burdukov also gives *muur* as colloquial Khalkha (also in Manzhigeev), and Mayorov gives *mis* as colloquial Kalmuk. Other dialect forms and variants are moor, moora, *moor*, *meer*, *mir*, *moro*, *miore*. All these names are evidently onomatopoeic. Male and female are designated by *ere* and *eme*.

arsalan, *arsala(n)*, (62). Lion, *Felis leo*.

bars, *bar*, (63). Tiger, *Felis tigris*. This word means "tiger" primarily but is also applied to the leopard. In formal literature the Sanskrit name shardula is sometimes used for "tiger."

irbis, *irbis*, (64). Snow leopard, *Felis uncia*. Although most frequently applied to this animal and used by some Russian zoölogists as a vernacular name for it, *irbis* is also sometimes applied to the ordinary leopard and to the tiger. *Felis uncia* is sometimes called "ounce" in English, but the ounce is properly the lynx (indeed "ounce" and "lynx" are derived from the same classical root) and irbis would be the best vernacular name.

silügüsün, *shülüüse(n)*, (65). Lynx, *Lynx lynx*. This protean name is both written and pronounced in many different ways, but all recognizably related to the forms here given. Kovalevskiy quotes a fanciful literary form oi-iin nokai, (66), literally "dog of the forest."

manul, *manul*, (67). *Felis manul*. Podgorbunskiy also gives an apocopated Khalkha form *man*. The word is eastern Turkish, in the same form, *manul*.

In addition to the above common names for felids, there are several literary names little used or not used colloquially in Khalkha. These include (from Kovalevskiy) barcik or barsik, (68), and bürügesü, (69), "small panther," borong, (70), "wild cat," malur, (71), "a kind of striped wild cat," tsogontai, (72), "wildcat" (the meaning is obscure but perhaps indicates an animal with a burrow), and gendü, (73), "small male panther, male carnivore." Przhevalskiy in Büchner gives *mori-chelesün* for *Felis pallida*, perhaps, in the transcription used here, *mori(n) shülüüse(n)*, literally "horse-lynx."

CARNIVORA PINNIPEDIA

kab zigasun, *khab dzagasa(n)*, (74). Any pinniped, seal or walrus. *Dzagasa(n)* means "fish." *Khab* is a sort of intensifying particle or exclamation, usually before another word beginning with *kh-*, and also is applied to a certain kind of small dog. Its significance in this phrase is obscure.

CETACEA

Kalimu, (75). Whale, compare Manchurian *kalimu.* A literary form in Mongolian.

buu dzagasa(n). Whale. This is homophonous with "gun fish," but the connection is not apparent.

aborgo zigasun, *aborgo dzagasa(n)*, (76). Whale. The name is descriptive only and means "enormous fish." It is also applied to the sturgeon and to porpoises or dolphins.

PROBOSCIDEA

zagan, *dzaan*, (77). Elephant.[1]

mamont dzaan. Mammoth, *Mammonteus primigenius.* This is not the origin of "mammoth," "mammut," "mamont," or other forms of this international word, but on the contrary is a recent loan-word from Russian. It is universally stated that "mammoth," etc., is from a "Tartar" word, but no similar or possibly cognate word is known in Mongolian and as far as I have been able to discover none is known in any Asiatic language to which the extremely vague designation "Tartar" might apply. If this is really the origin of the word, it appears either to have been lost in living native languages or to have been borrowed in an unrecognizably distorted form.

Podgorbunskiy says that some Buryats call the mammoth remains *arsalan zan* [*zan* is the Buryat equivalent in some dialects of Khalkha *dzaan*], "lion-elephant," and also that the elephant is sometimes called *arsalan*, properly "lion," by the Buryats. The confusion suggests the fact that uneducated Buryats had no idea what either an elephant or a lion really looked like.

PERISSODACTYLA

Horsemen from the earliest known times, the Mongols have a very large vocabulary for horses and everything relating to them. Only a few of these words are given here.

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[1] Aside from numerous encounters with elephants in the days of their conquests and the important rôle of elephants in Buddhist and other southern stories, elephants have been exhibited in Urga (Ulaan Baator), and also in Lhasa.

morin, *mori*(*n*), (78). The domestic horse in general.

gegü (and several recognizable variant spellings), *güü*, (79). Mare.

azirga, *adzarga*, (80). Stallion.

unagan, *unag*(*an*), (81). Colt (in its first year.)

dagagan, *daaga*(*n*), (82). One-year old colt (i.e., in its second year).

sidüleng, *shüdeleng*, (83). Two-year old colt (in third year.)

kizagalan, *khidzaalang*, (84). Three-year old colt (in fourth year).

soyogalan, *soyoolong*, (85). Adult horse (in fifth year and later).

Some of these are names like *shüdeleng*, can be applied as qualifiers to other animals, such as sheep.

akta, *agta*, (86). Properly "gelded" of "gelding" of any sort, as in *agta mori*(*n*), "gelded horse," but also used alone, as is "gelding" in English, to mean a gelded horse. Cf. *ata*, "gelded camel."

elzigen, *eljige*(*n*), (87). Domestic ass.

lagusa, *luus*(*a*), (88). Mule.

taki, *takhi*, (89). Wild horse, *Equus przewalskii.* This word is generally omitted from colloquial dictionaries but it occurs in Mongolian literature and is also given by Przhevalskiy, so it is certainly a Mongolian word and is probably now in use in this sense.

zerlik adagun, *dzerlik aduu*(*n*), (8 + 11). Literally "wild herd [of horses]," given by Przhevalskiy, "dzerlik-adu, i.e., 'wild troop,'" as Mongolian for "wild horses." It is not clear whether wild or feral horses or, as is probable, both are meant to be included. It is apparently merely a literal description and not properly a name for these animals.

kulan, *khula*(*n*), (90). Asiatic so-called wild ass, *Equus hemionus.* See remarks on the next word.

cikin-tei, cikitei, *chikhitei*, (91). This is the true Mongolian form (written and spoken Khalkha) of the word that has reached us as "*dschagatai*," "*jagatai*," and in various other guises as a Mongolian name for *Equus hemionus.* It is merely the unitive case of *chikhi*(*n*), "ear," and it means "eared, eary, with ears." As an epithet it is equivalent to "Hey, you with the ears!" and is applied to anything with striking ears. It is not specifically a name for *Equus hemionus.*

There has been much confusion regarding the names "kulan," "*chikhitei*" (in its various transformations), and "kiang." Some authorities have held that these are three races, characterizing Turkestan, Mongolia, and Tibet, respectively, others that "kulan" is the Turki and "chikhitei" the Mongolian name for one race, the kiang being different, others that "chikhitei" is the Mongolian and "kiang" the Tibetan name of one race, the kulan being different, and still others that these are Turki, Mongolian, and Tibetan names for the same animal. Without entering into the zoölogical problem as to the separability and distribution of races, the following seem to be the facts regarding these three words. "Kulan," with minor differences in local pronunciation, is a pan-Altaic word, occurring in Mongolian, Turki, and related languages and dialects, applied by all these peoples to any representative of this group of animals, whether it live in Turkestan, Mongolia, or Tibet. "Kiang" is the Tibetan word of equivalent application. Since the Tibetans have little to do with other countries, it happens that "kiang" is mostly used of the Tibetan animals, which is merely a function of the distribution of the language to which it belongs and not anything specific in the meaning of the word. "Chikhitei" is purely Mongolian and is a descriptive or fanciful cognomen, such as are common in Mongolian, for the animal of which the proper name in Mongolian as in Turki is "Kulan" [*khula*(*n*) in Khalkha dialect].

ARTIODACTYLA

SUIDAE

gakai, *gakhai*, (92). Domestic pig. The male is *ere gakhai*, bodong, or *bodong gakhai;* the female *eme gakhai* or *meg*(*e*)*ji;* the young *gakhai dzuldzaga.*

megeji, *meg*(*e*)*ji*, (93). Sow.

bodong, *bodong*, (94). Wild boar, boar. Also *dzerlik gakhai*, literally "wild pig," and *ang gakhai*, literally "game pig."

kaban, *khaban*, (95). Boar, pig. Cf. Russian *kaban.*

The following names are chiefly or wholly literary: kubusun, (96), "boar," asamak, (97), "gelded pig," toroi, (98), "suckling pig," torogoi, (99), "young pig."

CAMELIDAE

temegen, *temee*(*n*), (100). Camel. There appears to be no special name for wild camels, which are called *dzerlik temee*(*n*), "wild camel," or *temee*(*n*) *göröös*(*ön*), "camel beast." The latter is given by Vladimirtsov (note to the Panchatantra) in a literary form.

bugura, *buura*, (101). Male camel.

inggen, *ingge*(*n*), (102). Female camel.

ata, *ata*, (103). Gelded camel. Or *ata temee*(*n*).

botogon, *botogo*(*n*), (104). Young camel.

torom, *torom*, (105). Yearling camel.

taiylak, *tailig*, (106). 2-year old camel.[1]

CERVIDAE

bugu, *buga*, (107). Deer, buck. Especially *Cervus elephas* but also a general term for cervids. It is used with many different qualifiers to form descriptive and local designations for various sorts of deer.

sogo, *sogo*, (108). Doe, especially of *Cervus elephas.*

ili, *ili*, (109). Faun, especially of *Cervus elephas.*

zorgul, *dzorgul*, (110). Yearling deer, especially of *Cervus elephas.*

kandagai, *khandagai*, (111). Moose, elk in the European sense, *Alces* sp. Podgorbunskiy gives variants of büir, *büir*, (112), for the male and of ingge, *ingge*, (102), for the female among Buryats but these are also used for other animals, at least in Mongolian generally, e.g., for camels.

maral, *maral*, (113). Wapiti, *Cervus canadensis.*

küderi, *khüdere*, (114). Musk deer, *Moschus moschiferus.*

zür, *dzür*, (115). Roe-buck, *Capreolus pygargus.*[2]

segül urto bugu, (118), which would be spoken *süül urta buga.* Literally "tail-long deer," a literary expression for the "mi-lu" (its Chinese name), the mysterious domesticated *Elaphurus davidianus.*

BOVIDAE

üker, *ükher*, (119). Domestic horned cattle, cow in a general sense.

buka, *bukha*, (120). Bull.

üniyen, *üniee(n)*, (121). Cow.

sir, *shar*, (122). Ox.

tugul, *tugal*, (123). Calf.

biragu, *biruu*, (124). 2-year old calf.

gunan, *gunang*, (125). 3-year old ox or bull.

gunazin, *gunajing*, (126). 3-year old cow.

dönen, *dönüng*, (127). 4-year old ox or bull.

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[1] Most Turkish dialects have a word cognate with this but with a curious shift of meaning, applying it to horses, not camels.

[2] This definition is reasonably certain but the Russian linguistic works are confused and contradictory for this and several other words, making no clear distinction or disagreeing with each other as regards goats, antelopes, and some deer. The words need checking by a zoölogist in the field. Aside from *dzür*, the following may be mentioned:

Gura (116), defined by Kovalevskiy in Russian as "samets dikikh koz" ("male wild goat") but [illegible] kiy gi[illegible] *gurogun, guran* as Buryat for "koza, kozulya (capreolus pygargus Pall.): samets (kozel)" ("roebuck, male goat").

Inzagan (117), defined by Kovalevskiy as "chevreuil, chevrau, jeune chèvre de sibérie" and by Bimbaev as "kozlenok dikoy kozi" ("kid of the wild goat") while Podgorbunskiy gives the corresponding colloquial *indzaga* as Buryat for "young goat, kid."

dönezin, *dönjing*, (128). 4-year old cow.

sarlok, *sarlok*, (129). Yak.

kaiinok, *khainok*, (130). Cross from a bull yak and ordinary cow.

konin, *khoni*, (131). Domestic sheep.

kutsa, *khutsa*, (132). Ram, also called *ere khoni*. A ewe is *eme khoni*, or simply *khoni*.

irgen, *irge*(*n*), (133). Wether.

kuragan, *khuraga*(*n*), (134). Lamb. There are also qualifiers, used with some variations for several different animals, which prefixed to *khoni* designate, in the order given, sheep in each of their first three years: *shüdeleng*, *khidzaalang*, and *soyoolong*.[1]

argali, *argali*, (135). Wild sheep, especially *Ovis argali*.

imagan, *yamaa*(*n*), (136). Goat.

teke, *tekhe*, (137). Male goat, also called *ere yamaa*(*n*). A female goat is *eme yamaa*(*n*) or simply *yamaa*(*n*).

serke, *serkhe*, (138). Castrated goat.

isigen, *ishig*, (139). Kid.

ulagan imagan, *ulaan yamaa*(*n*), (140). Ibex, *Aegocerus sibirica*, according to Przhevalskiy. Literally "red goat." I cannot surely confirm this designation nor have I found any unequivocal root name for the ibex unless possibly some of the words given by the Russians for "wild goats" refer to this form, see note on p. 22.

küke imagan, *khükhü yamaa*(*n*), (141). Literally "blue goat," Przhevalskiy gives this ("*kuku yaman*") as the Mongolian name of the nahur or burrhel, *Pseudois nayaur*.[2] It is, however, noteworthy that there is a literary word kübker, kübkür, (142), kübker imagan, defined by Kovalevskiy as designating a yellowish-gray wild goat living in hollows in the mountains. It is at least possible that this root and not that for "blue" is involved in the name *khükhü yamaa*(*n*), and that kübkür in a spoken form *khü*(*b*)*khü*(*r*) has been assimilated to *khükhü*, "blue," either by the European ear or, because of its real resemblance and sensible meaning, by the native speakers themselves Golstunskiy also gives kübker imagan and equates it with imagan görögesön, "goat beast," i.e., wild goat, an appropriate name for the ibex or for the nahur.

zegeren, *dzeeren*, (143). Antelopes, *Gazella gutturosa* and *subgutturosa*. Przhevalskiy confines this name to *Gazella gutturosa* and always calls *Gazella subgutturosa* "*karasulta*," that is, kara segültei, *khara süül-*

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[1] So according to Burdukov, but the same three terms apply to horses in their third to fifth years, respectively.

[2] There is nothing improbable in an animal's being called "blue." This adjective is often applied to gray horses.

tei, literally "black-tailed." This is a valid local differentiation by description, but the root word *dzeeren*, which occurs in different but recognizable guises among the Altaic or Turko-Mongolian dialects all over Central Asia, is certainly applied by various peoples to both species, and indeed is used of gazelles in general.[1]

ZODIACAL ANIMALS

The Mongols early adopted and long used the Chinese zodiac and the calendar in which a sixty-year cycle is formed by combining the names of twelve animals, mostly mammals, with the names of the five elements and the words "male" and "female." The twelve zodiacal animals are listed in Mongolian by various travelers (e.g., Huc, Przhevalskiy) and by most grammarians. In the usual order, they are as follows[2]:

1.—kuluguna, *khulagana*, (38), mouse (or rat).
2.—üker, *ükher*, (119), cow (or ox).
3.—bars, *bar*, (63), tiger or leopard.
4.—taulai, *tuulai* (29), hare.
5.—lou, *luu*, (146), dragon (this word is taken bodily from the Chinese, whereas all the others in this list were translated into Mongolian).
6.—mogoi, *mogoi*, (147), snake.
7.—morin, *mori(n)*, (78), horse.
8.—konin, *khoni*, (131), sheep.
9.—micin, *michi(n)*, (19), monkey.
10.—takiia, *takhyaa*, (148), hen (or fowl).
11.—nokai, *nokhoi* (41), dog.
12.—gakai, *gakhai*, (92), pig.

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The following references suffice as authority for most of the statements made, but omit many of the linguistic works, most of the zoölogical studies, and almost all the general works of exploration and travel consulted. A complete list of works seen in any one of these three fields would be too long for publication here.[1]

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[1] To give but a single example, Miller (in Carruthers) says that the "Chantos" (eastern Turks) call *Gazella subgutturosa* "jeran." He adds that "the nomads," but which he probably means the likewise Turkish Kirghiz, call it "kara karuk (black tail)," which is parallel with the Mongolian *khara suultei*.

[2] Marco Polo (Vol. I, Book II, Chapter XXXIII, of the Yule-Cordier edition) gives the calendar animals as "The sign of the first year . . . the Lion, of the second the Ox, of the third the Dragon, of the fourth the Dog, and so forth up to the twelfth." This has provoked discussion because it seems certain that the animals were never really used in Polo's order and doubtful whether [illegible] cycle in Mongolian and thence read "lion" for "tiger" or "leopard." [illegible] fact such a mistake is extremely unlikely in Mongolian—Polo would hardly mistake "bars" for "arsalan" and I find no evidence that "bars" ever meant "lion." Pelliot (Journal Asiatique, 1912, p. 592) has already pointed this out, and he concludes that it fortifies the opinion of Yule, Cordier, and himself that Marco Polo knew no oriental language except Persian (in which "lion" and "tiger" are confused). While hesitating to quarrel with such overwhelming authority in a field not my own, I am convinced that Marco Polo did know some Mongolian, as he says he did, but the evidence is not *a propos* here.

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[1] Without specific reference to this paper but in connection with Mongolian studies generally I am greatly indebted to Mr. A. I. Ward for facilitating examination of books and manuscripts in his remarkable collection and for other assistance, as well as to Mr. D. Gneditch for skilful translation of several Russian works (including one particularly used in preparing this paper, as cited below).

It should be mentioned that the works of Soulié and of Whymant cited were not relied on for any statement here made. They are cited because they are almost the only readily available works on Mongolian in western European languages, but they are not considered authoritative.

All the works cited below are in my own library or that of this Museum, or both.

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COLEOPTERA FROM THE GALAPAGOS ISLANDS

By Andrew J. Mutchler

During the past few years several lots of beetles from the Galapagos Islands have been added to the American Museum collection. These were, for the most part, collected on two expeditions. The one in 1925, known as the Templeton Crocker Expedition to the Pacific Islands, was principally concerned in gathering materials for groups of birds to be placed in the Whitney Memorial Hall and in making a collection of Pacific Island archeological materials including studies of the Pitcairn Islanders. The entomological collections were merely incidental.

A visit to Indefatigable Island in 1935 and 1936 by Dr. Wolfgang von Hagen was preliminary to a survey which he hopes to make of the Galapagos Archipelago.

In making his collection of insects, Dr. von Hagen divided the localities into "Ecological Zones" which he refers to as "Zones A, B and C." The first, zone "A," is along the beach just back of tide water. The second "B" includes the vegetation on the lower lands a short distance back of the beach and the third "C" the more elevated portions of the island.

The new species of *Neoryctes* is from material in the United States National Museum. A note concerning this species and *N. galapagoensis* will be found under the specific headings.

A specimen which proved to be a new species of *Monochammus* was collected by Mr. Clarence Hay. It seems almost unbelievable that this genus should appear as far south as the Galapagos Islands. We know of no species having been recorded in America farther south than Mexico; and when Bates described that species in 1880 he remarked "The following is the first yet recorded from America south of the United States." To the best of my knowledge none other has been recorded since that time to this date.

In looking over the Museum collection of unidentified material I came across two other specimens of *Monochammus* labeled "Cocos Isld." This is also a Pacific Island south of Costa Rica located approximately 5° north latitude and 87° west longitude. This makes it appear that the genus should occur in the Pacific Islands rather then being mainland species which were accidently introduced there. Still more convincing is the fact that these two forms are new to science and are closely related. I have, on account of its close relationship with the Galapagos Island species, included a description of the Cocos Island form in this paper.

A list of the species recorded and described since 1925, including the new forms herein described, with bibliographic references is contained in the pages following the descriptive matter.

The illustrations for this article were made by Mr. Pierre-Noël.

Cicindela vonhageni, new species

Figure 1

Head rugose punctate, metallic coppery to more or less yellow, the yellow markings may consist of a triangular spot reaching from the bases of the antennae and ending in more or less of a point between the eyes, this spot may also be quite small or there may be other spots at the base of the head; labrum pale, narrowly bordered with blackish; front margin with a small triangular tooth at the middle; mandibles darker than the labrum with the apex and margins black; antennae pale with the apical end of the joints narrowly black. Pronotum metallic coppery but often more or less intermixed with yellowish brown; rugose punctate and with a few short white hairs at the sides; sub-apical transverse impression somewhat deep, bisinuate, sub-basal also deep and bisinuate, a median impressed line connects these two impressions. Scutellum coppery, more or less brownish yellow or wholly brownish yellow; cribrately punctate. Elytra usually wholly pale dirty white but sometimes with indications of darker at base between the scutellar region and the humeri; punctures moderately fine with a row of coarser ones near the suture. These coarser punctures start near the suture at base of the scutellum and form a sinuous line along the sutural region; lateral apical angles broadly rounded, sutural angles acute, somewhat pointed. Under surface usually brownish yellow throughout, or this may vary, the pro-meso- and metasternum may be darker or as in one specimen the pro-meso-metasternum and sides of two abdominal segments are coppery; sides of pro-meso and metasternum sparsely covered with moderately short white hairs; the front and middle coxae also with a few white hairs; abdominal segments with sparse white hairs at the sides and a row of bristle bearing punctures along the sub-apical margins; hind legs moderately long, the femora reaching approximately to the end of body, tibiae about the same length as the femora; tarsal joints with their apical ends darker. Length, 13.5–14.5 mm.

The holotype male, allotype female, one male paratype, five female paratypes, and one badly broken female were collected by Dr. Wolfgang von Hagen at Tortugas Bay, Indefatigable Island, Galapagos, November 13, 1935 at 7:30 A.M., in a zone which is termed by the collector "Ecological Zone A. littoral."

There is very little difference between the male and female except that the female is larger and as in other members of this genus the apical abdominal segments differ.

Among the series of nine specimens there are only three that have a full completement of the antennal joints. I have not seen specimens of *C. galapagoensis* but the above is no doubt totally different. It is larger and the elytra are almost immaculate, whereas in *galapagoensis* the elytra have a humeral lunule, a middle band and other markings which would at once distinguish it from *vonhageni.*

Calosoma howardi Linell

This apparently common species has heretofore been listed from seven islands in the Galapagos Archipelago. The collection now before me adds Indefatigable Island to the list. There are four specimens from Academy Bay and three from Conway Bay, May 17–22, 1935, Crocker Expedition. Two specimens "Ecological Zone C," January 29, 1936, at 7 o'clock A.M., Dr. Wofgang von Hagen.

Selenophorus obscuricornis (Waterhouse)

Two specimens of this species were collected by the Crocker Expedition at Tagus Cove, Albemarle Island, March 10, 1935, and five by Dr. Wolfgang von Hagen on Indefatigable Island, October 20, 1935. These latter were recorded from "Ecological Zone C." The only island heretofore specifically mentioned was by Mr. Blair, who recorded it from James Island.

In placing this species in the genus *Amblygnathus* in my former paper (Zoologica, V, p. 234), I merely followed the records of Waterhouse and Linell, but now that I have seen specimens of the species I agree with Blair (1933, Ann. Mag. Nat. Hist., (10) V. XI, 472) that it should be placed in the genus *Selenophorus.*

Tropisternus lateralis (Fabricius)

Two specimens, Indefatigable Island, "Ecological Zone C," Dr. Wolfgang von Hagen.

Alloxacis collenetti Blair

Crocker Expedition. One Tortugas Bay, Indefatigable Island, "Ecological Zone A, littoral" November 13, 1935, Dr. Wolfgang von Hagan.

Necrobia rufipes DeGeer

Two specimens, Indefatigable Island, "Ecological Zone C," October 30, 1935, Dr. Wolfgang von Hagan.

Cissitis maculata Swederus

One specimen, Indefatigable Island, flying within "Ecological Zone A," at 7:30 P.M., Dr. Wolfgang von Hagan.

This specimen does not agree in all details with the description of *maculata.* The antennae are piceous at the base, becoming paler and more reddish apically, the apical segment being a pale red. Each elytron has the basal mark as in *maculata* but the two median and two subapical spots are replaced by somewhat broad, more or less jagged-edged bands. Otherwise this specimen is like those of other *C. maculata* in the American Museum collection.

Anchastus quirsfeldi, new species

Figure 2

Black, antennae, mouth-parts, labrum, and legs median pale brown. Head moderately coarsely and somewhat closely punctate; pubescence brown, sparse; labrum somewhat closely punctate; with somewhat long hairs which are appressed forward; antennae moderately serrate from the third joint, basal joint stout slightly curved, second joint very short, less than one-half length of next, third shorter than the fourth, fourth to tenth subequal in length, eleventh somewhat longer and ending in a rounded point; the antennae are covered with a pale pubescence with sparsely placed longer hairs along the sides and apical margins. Pronotum wider than long; moderately finely but not very closely punctate; pubescence sparse (possibly rubbed); basal angles somewhat pointed and with two carina, the outer one longer than the inner but connecting with it at the apical angle. Scutellum narrowly rounded at apex; not closely punctate and with hairs arising from the punctures. Elytra parallel to about apical third, then gradually narrowing to apex; with nine striae, seven of these are well marked basally, the others somewhat obsolete, all except the sutural striae are more or less obsolete apically; intervals nearly flat and with two series of somewhat small punctures; except on the apical portion where the striae are obsolete; pubescence sparse, moderately long, slightly more dense along the sides and at apex. Under surface somewhat finely and closely punctate; pubescence short and sparse. Length, 13 mm.

Type, paratype, Indefatigable Island, Galapagos Islands, "Ecological Zone C," October 20, 1935, Dr. Wolfgang von Hagen collector.

Aeolus fuscatus Steinhal

One specimen from Charles Island and one from Indefatigable Island "Ecological Zone C." The latter, collected by Dr. Wolfgang von Hagen, may be the above species but the identification is more or less doubtful. They are 6–6.5 mm. in length. The thorax and elytra are reddish brown, but the thoracic angles and margins of the elytra are not paler. The hind angles of the thorax are slightly divergent, the carina is somewhat distinct and extends some distance beyond the base of the thorax. The head and pronotum are quite finely and somewhat densely punctate.

The pubescence on the head and pronotum is quite sparse, especially on the disk. The striae of the elytra are well marked, and the intervals are flat, the pubescence (probably rubbed) is somewhat more sparse on the disk than at the sides and apex in the Charles Island specimen, but in the other it is more uniform. The body beneath is similar in color to the upper surface; closely punctate and with short sparse pubescence. Legs pubescent and slightly paler.

A free translation of the original description of *A. fuscatus* is as follows: Dull reddish brown, pubescent, thoracic angles, and margins of the elytra paler. Prosternum at the sides densely punctate. Antennae fuscous, legs flavous. Length, 6.5 mm.; width of elytra, 1.8 mm.

It belongs in Candeze's Section 1 Subdivision III and probably closely related to *A. binotatus*. The hind angles of the prothorax are hardly divergent, long, but feebly carinate. The yellow area of the upper side merges into the dark parts, particularly the pale spot on the suture and pale suture. Head and prothorax paler above than the elytra and more reddish.

Described from one specimen collected at Nare, Colombia. I have been unable to find any record of this species being recognized since 1875 when the original description appeared.

Temnochila galapagoensis, new species

Figure 4

Elongate, black with a metallic green reflection. Head moderately finely not closely punctate; front behind the labrum with a circular indentation and with a smaller one each side; there is a moderately deep impression at each side of the head near the front, there is also a median impressed line which extends along the apical half. Pronotum wider than long; apical angles projecting forward, hind angles obtuse; not very closely punctate but with an intermixture of larger and smaller punctures. Elytra elongate, parallel to about apical third, nearly three times as long as the thorax; striate punctate; the striae are not at all impressed but consist of alternate rows of larger and smaller punctures on the disk, on the sides the punctures are fine and nearly of equal size; near the apex of the elytra the sutural stria curves outward and then back again to near the suture; sutural angles narrowly rounded. Body beneath punctate with fine and coarser punctures, thoracic segments sparsely, abdominal segments more closely. Length, 15–16 mm.

MALE.—Sub-mental area with a somewhat large projecting armature. The fifth and sixth abdominal segments broadly impressed, concave.

FEMALE.—Sub-mental area smooth, abdominal segments convex. Holotype, male, allotype, female, and one female paratype, collected by Dr. Wolfgang von Hagen on Indefatigable Island, "Ecological Zone C," October 20, 1936.

This species apparently belongs in Sharp's group E in which the pronotum behind the coxae is smooth, not conically prominent. On the

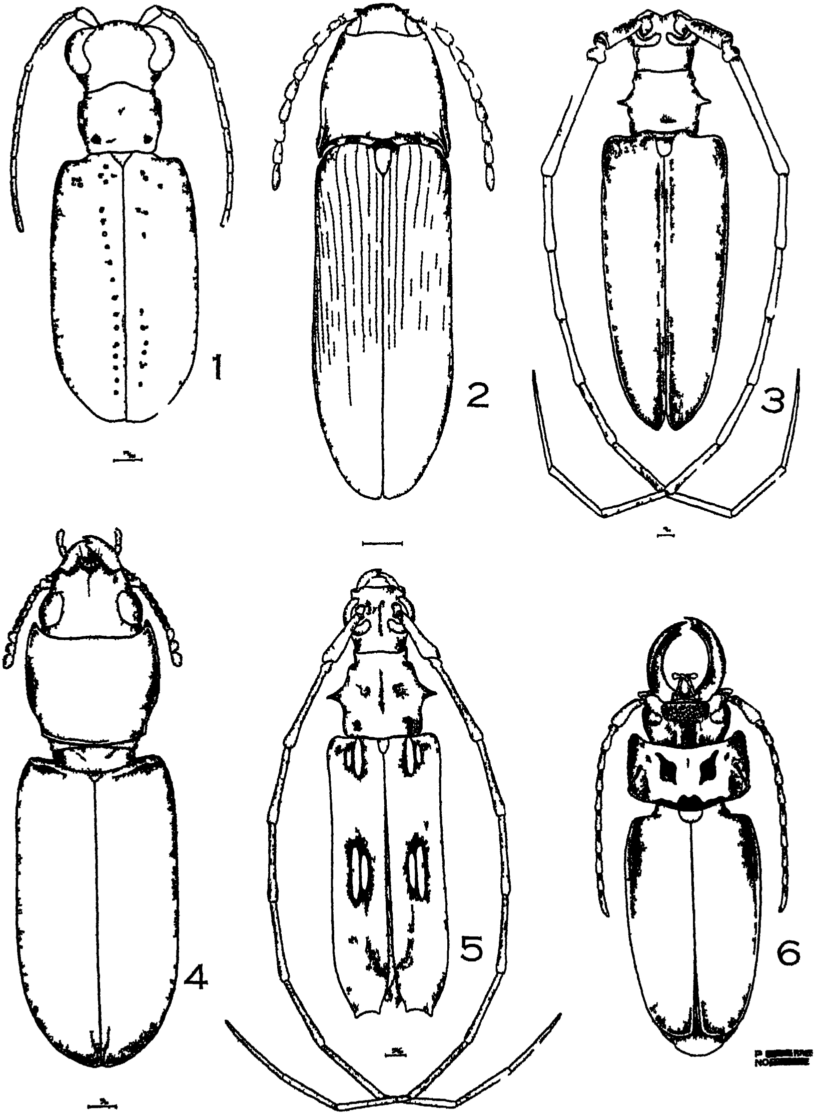


Fig 1 *Cicindela vonhageni*, new species. Fig 2. *Anchastus quirsfeldi*, new species Fig 3 *Monochammus hayi*, new species Fig 4 *Temnochila galapagoensis*, new species Fig 5 *Eburia lanigera* Linell, male Fig 6 *Stenodontes* (*Mallodon*) *galapagoensis*, new species

second, third, and fourth ventral abdominal segments of the male there is near the base and laterally a group of more closely placed punctures.

Cycloneda sanginnea (Linnaeus)

Eight specimens of this widely distributed species were collected by the Crocker Expedition on Indefatigable Island, four from Conway Bay, March 19, and four from Academy Bay, March 24 and 25, 1935. All of the specimens have the pale area on the elytra at the base near the scutellum. The head is variable in color from almost wholly black to wholly yellow. The thoracic markings on four specimens agree with the typical form. The others vary as follows: with the pale apical median branch of the pale margin present, the lateral ones connected with the lateral margin enclosing a black spot; or with apical median branch absent, front of pale margin more or less incomplete, with the lateral branches disconnected from the pale margin, therefore this marking is merely represented by a pale spot.

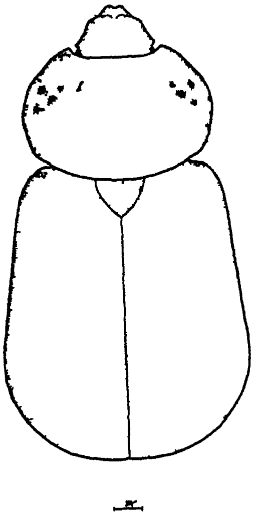
Olla abdominalis (Say)

Eight specimens of this species were collected by Dr. Wolfgang von Hagen on Indefatigable Island, "Ecological Zone C," November 5, 1935.

These specimens belong to the typical form of *abdominalis,* but there is a variation in the number and density of the spots on either or both the pronotum and elytra. Seven of the specimens have seven spots on the pronotum referred to by Say in his original description, although some of these spots are reduced in size or, as in one specimen, they are barely indicated. The other specimen has the middle basal spot missing. The elytra in five have markings similar to those described by Say, although one or more of the spots are only vaguely marked. Three others have the spot nearest the scutellum missing. The one apical and three middle spots are present on all the specimens. All have the surface underneath and legs pale.

Pedoneces morio Boheman

Two specimens which were collected by Dr. Wolfgang von Hagen on Indefatigable Island, "Ecological Zone C," October 20, 1935, agree in most details with Boheman's description of this species. They are slightly larger, measuring 6–6.5 mm. in length and 2.5 mm. in width; also the antennae in one specimen are more piceous red than ferruginous, with the apical joints paler. The legs are piceous red with the tarsi very little, if any, paler. In the other specimen these same parts are darker piceous, except the apical joints of the antennae which are piceous red.



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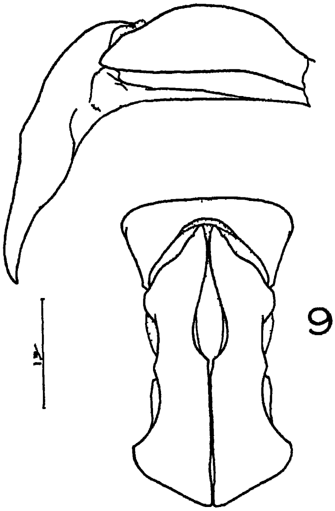

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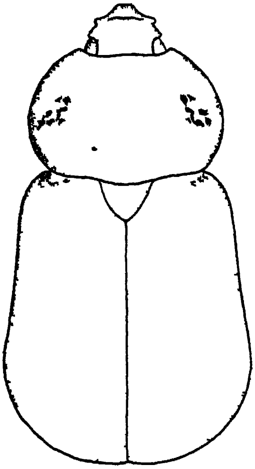

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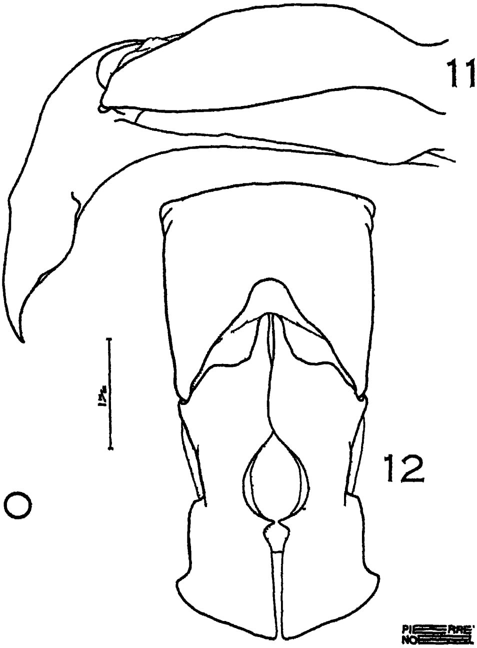

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PIERRE NOEL

Fig 7 *Neoryctes galapagoensis* (Waterhouse) Figs 8 and 9 (*Neoryctes*) *galapagoensis* Aedeagus of male Fig 10 *Neoryctes linelli*, new species Figs 11 and 12 *Neoryctes linelli* Aedeagus of male

Stonium laevigatum Waterhouse

Six specimens, Tagues Cove, Albemarle Island, March 10, 1935, collected by the Crocker Expedition.

These specimens agree with Linell's description of *S. bauri* but I have placed them here as *S. laevigatum* on the assumption that *bauri* is a synonym of that species.

Ammorphus obscurus Waterhouse

Eight specimens, Tagues Cove, Albemarle Island, March 10, 1935, collected by the Crocker Expedition. Two specimens, Indefatigable Island, "Ecological Zone C," and one, Academy Bay, Indefatigable Island, collected by Dr. Wolfgang von Hagen. One specimen, Charles Island.

This species is apparently widely distributed throughout the Archipelago and from records and the number of specimens collected on different expeditions it is apparently very common.

Schistoceros galapaganus Lesne

One female specimen from Indefatigable Island, collected by Dr. Wolfgang von Hagen.

Neoryctes galapagoensis (Waterhouse)

Figures 7, 8, and 9

Three specimens, one male and two females, collected by Dr. Wolfgang von Hagen on Indefatigable Island, "Ecological Zone C," October 21, 1933, were taken with other material to the U. S. National Museum for comparison. The *Neoryctes* were compared with specimens listed by Linell as *Pseudoryctes galapagoensis.* The generic name being changed later by Arrow to *Neoryctes.*

One of the Linell specimens had been sent to the British Museum for comparison with the Waterhouse type and was returned with the following note: "*Neoryctes? galapagoensis?* hair rubbed off." Dr. Chapin and I compared the two series of specimens and found several external differences. We therefore decided to extract the aedeagus of the two forms. A comparison of these convinced us that we were confronted with two species. We therefore compared the specimens with the original description and became convinced that the ones collected by Dr. von Hagen were representatives of *N. galapagoensis* and that the specimens collected by Dr. G. Bauer on Chatham Island and listed by Linell as *galapagoensis* represented a new form of which the following is a description.

Neoryctes linelli, new species

Figures 10, 11, and 12

Somewhat pale reddish brown, head, pronotum, scutellum, and elytra narrowly margined with darker color. Head shining; with a few coarse, deep set punctures especially on the ocular region; mandibles prominent, strongly rounded. Pronotum moderately closely punctate, with a mixture of coarser and finer punctures; anterior angles acute, posterior rounded. Scutellum triangular, narrowly rounded at the apex; minutely alutaceous. Elytra alutaceous, punctate, the punctures arranged in rows basally but becoming more confused and less evident apically. Propygidium somewhat closely punctate, with a short pale yellow hair arising from each puncture and with two longitudinal bands forming the stridulating organs; pygidium glabrous; sparsely punctate. Underside of head punctate, not closely so, but with a somewhat long hair arising from each puncture. Pronotum punctate and with hairs which are more closely placed along the margins, meso- and metanotum more sparsely hairy; abdominal segments sparsely hairy at the sides and with a row of bristle bearing punctures along the subapical margin. Front tibiae margined with black and with a more or less confused row of bristle bearing punctures on the outer surface. In the female this surface is moderately coarsely punctate throughout. In the male these punctures are much finer; middle and hind tibiae with bristle bearing punctures. Length: male, 16–19 mm.; female, 23 mm.

Holotype male, allotype female, and four male paratypes, in collection of the U. S. National Museum. One male paratype in collection of The American Museum of Natural History. All from Chatham Island.

REMARKS.—The male has the clypeus slightly larger and more sinuate than the female. The posterior angles of the pronotum are obtuse in the female, rounded in the male. The stridulating organs form two longitudinal bands on the middle of the propygidium, these are parallel in the female, convergent to the apex in the male. The apical margin of the propygidium is feebly rounded in the female, it is prolonged into an acute angle in the male. The pygidium is convex and entirely glabrous in the male, the female pygidium has a slight rounded impression at the middle and the margins are ciliate. The anterior tibiae is quadridentate in the female, tridentate in the male.

This species is similar to *galapagoensis* but differs in several characters. The female of *galapagoensis* has the calcar of the anterior tibiae spatulate, in *linelli* it is acuminate. The teeth on the outer margin of the anterior tibiae differ but this may be due to wear. The calcari of the posterior tibiae in *linelli* are strongly flattened and widened, becoming wider apically. In *galapagoensis* the calcari are flattened but parallel-sided, except the smaller one which is abruptly acuminate at the tip. The males differ in that the stridulating ridges in *galapagoensis* are much less regular, the apical teeth much more prominent, and the elytra distinctly alutaceous. In *linelli* the pronotum is less sparsely punctured, the individual punctures smaller and more defined, the underside of the body is much less hairy, and the elytra more highly polished.

The specimens representing this new species are the actual examples that Linell had before him when he described the genus *Pseudoryctes.*

Stenodontes (Mallodon) molarius Bates

A series of this species, consisting of six male and eight female specimens, was collected by Dr. Wolfgang von Hagen on Indefatigable Island, "Ecological Zone C," November 10, 1935 to January 29, 1936. These specimens vary somewhat in size, the largest male (including mandibles) measuring 74 mm. in length and the smallest 58 mm. The large specimen is also much broader than the others, the thorax being 23 mm. wide and the elytra 25 mm.

A single male specimen similar to the above, but differing in many respects, was collected January 29, 1936. The following is a description of the specimen which I believe represents a new species.

Stenodontes (Mallodon) galapagoensis, new species

Figure 6

MALE.—Elongate, oblong, piceous black. Head broad; front behind the mandibles coarsely and closely rugose-punctate; behind the eyes are several oblique ridges, those near the eyes somewhat deep but gradually becoming less so toward the middle; basal portion of occiput with a short longitudinal fovea each side of middle, between these foveae the occiput is comparatively smooth; mandibles somewhat elongate, gradually curved to apex; dorsal portion concave, this concavity extending to near the apex where there are two teeth, the inner being the longer, the concavity is sparsely punctate but the outer curved portion is more closely punctate with finer and coarser punctures; inner surface of mandibles with moderately long, not very dense brownish hairs; antennae with first joint slightly curved, sensitive surface gradually increasing from third to eleventh joint. Pronotum very similar to *molarius.* Scutellum broadly rounded at apex. Elytra finely punctate, the punctures well separated but distributed over the whole surface; lateral angles broadly rounded; sutural angles with a short sharp spine. Length, not including mandibles, 56 mm. Mandibles, 13 mm. long.

Holotype, Indefatigable Island, "Ecological Zone C," January 29, 1936, collected by Dr. Wolfgang von Hagen.

This species, although similar to *molarius,* differs from specimens in this and the National Museum in being more convex. The mandibles are different, being concave instead of convex above. The head behind the mandibles is coarsely and densely rugose, with two distinct elongate foveae on the occiput. The upper lobe of the eyes is more obliquely narrowed internally with the inner tips more acutely angulate. The scutellum is more broadly rounded at the apex; and the elytra are finely punctured throughout.

The drawing shows the palpus appearing above the base of the mandibles. This is as shown in the specimen, the mandibles being widely opened.

Eburia lanigera Linell

Figure 5

The female of this species was described by Linell, 1898, Proc. U. S. National Museum, XXI, pp. 259–260, from one specimen collected on Charles Island by the Albatross Expedition. There are now before me two male and six female specimens. To my knowledge the former sex has not heretofore been described.

Linell's description fits very well with the male but in this sex the antennae are much longer than the body, the four apical joints extending beyond the apex of the elytra, the second joint being longer than in the female, the joints from third to tenth not noticeably increasing in length, and eleventh joint about one-third longer than the preceding. The two male and six female specimens were collected on Indefatigable Island, "Ecological Zones A and C," November 17, 1935 to January 25, 1936, by Dr. Wolfgang von Hagen.

Dr. K. G. Blair, 1933 (Ann. and Mag. Nat. Hist., (10) XI, p. 181) says that the above species appears to him as only a variety of *E. stigma* Olivier and refers to the fact that the specimens collected by Mr. Bateson have much shorter spines on both femora and elytra than normal *E. stigma.* In comparing the Galapagos specimens with a small series of *E. stigma* from the West Indies I find that the spines, referred to by Blair, are shorter in *lanigera.* I also find that the pronotum of *lanigera* is smooth in comparison with *stigma* which has quite a number of small granules scattered over the disk. The elytra also show differences as follows: in *stigma* the base of the elytra is quite smooth, there is a line of dense pale pubescence along the suture and the pubescence on the disk is quite short, also the inner basal and outer middle ivory spot are quite narrow. The Galapagos specimens has the discal surface of the pronotum comparatively smoother: elytra with coarse punctures at base, pubescence comparatively long and not paler or more dense along the suture, inner basal and outer middle ivory spot usually not as narrow. A long series of specimens of both forms may bridge these differences but at present I feel satisfied to leave them as separate species.

Monochammus hayi, new species

Figure 3

FEMALE.—Elongate, cylindrical, black, shining. Head rugose-punctate; subapical margin with a transverse carina extending completely across from the base of mandibles, behind which is a deeply impressed line; middle of front with a short, narrow, smooth longitudinal carina; a short distance behind this carina is a longitudinal impression which extends between the bases of the antennae and continues to the base of the head; antennal bases very prominent; the pubescence consists of very short, white hairs with longer scale-like hairs around the margins of the eyes; antennae with the first joint roughly punctate, about one-half the length of the third, fourth slightly more than one-half length of third, fourth to eighth about equal in length (outer joints missing in the type). Pronotum rugose, with a somewhat broad sinuous impressed line behind the apical margin and another antebasal; each side with a somewhat robust spine which projects slightly upward; the pubescence consists of a few white scale-like hairs at the sides and a small patch of the same on the basal middle, the apical margin is fringed with very short, fine white hairs. Scutellum finely punctate; somewhat broadly rounded at apex and with a patch of scale-like hairs at the apical end. Elytra about four times the length of the thorax, obliquely prolonged apically and rather acute at apex; somewhat rugosely and confusedly punctured basally but becoming smooth and more sparsely and more regularly punctate apically; the vestiture on each elytron consists of a small patch of white scale-like hairs at the base between the scutellum and humerus, there are also traces of finer hairs along the lateral margin and apically along the suture. Ventral surface finely punctate and with patches of coarser and finer white hairs; legs elongate; finely punctured; pubescence fine with longer and coarser, black hairs on the apices of the femora and tarsi, pubescence on tarsal pads brown. Length, 27 mm.

This type specimen was collected by Mr. Clarence Hay on Indefatigable Island on his visit to the Galapagos Islands during April, 1930.

There seems to be no American species in this genus with which to compare this form, but in reading over Col. Casey's work on the North American species it apparently fits in the section No. 4 of his "Key": "Elytra each obliquely prolonged apically and rather acute at apex." The only North American species which Col. Casey placed in this group is *M. marmorator* which, except for the form of the elytra, is totally different from the above described species.

Monochammus cocoensis, new species

Head similar to *hayi*. Pronotum with a raised line at the apical margin; behind this, on the sides, is another raised line which fuses with the other on the disk. Each of these lines is, in some of its parts, separated into two or more narrow lines; behind these lines there is a somewhat deep canaliculation which curves toward the base on the disk where there is an indentation that in the male is quite broad and finely punctate. In the female this indentation is less deep and more shining. On the middle of the disk there is a longitudinal impressed line which is somewhat well marked for a short distance apically then appearing again behind the middle and continuing to a sub-basal impressed transverse line. In the longitudinal impressed line there is a row of coarse white hairs which possibly in fresh specimens continue the whole length of the pronotum (in the specimens before me this line of hairs is broken). There is a deeply impressed line before the sub-basal margin of the pronotum which continues around the sides behind which is a raised line, then another impressed line; the sub-basal margin is indicated by a raised line. Scutellum somewhat thickly covered with white hair. Elytra gradually sloping from the humeri to apex, each elytron ending in a somewhat narrow point; quite coarsely and more or less granularly punctate basally, becoming smoother and more finely punctate apically; the pubescence consists of a patch of white hairs at the base of each elytron between the humerus and scutellum and some microscopic hairs protruding from the punctures, these hairs are slightly more dense along the margins apically. Under surface finely punctured and with short, sparse, white hairs. Length: male, 33 mm.; female, 29 mm.

Holotype, male, and allotype, female, from Cocos Island.

These specimens, although not perfect, are sufficiently so to allow for a description. The most imperfect part is that the male has one antenna missing but six joints of the other are present. Seven joints of one antenna and four joints of another are present in the female. The six joints of the male antennae are approximately one-sixth longer than those of the female. The third joint is about 13 mm. long in the male and 11 in the female. All of the other joints are in similar proportion.

The third joint in the Galapagos specimen is shorter than in the female of this species. As in the Galapagos species this one belongs in Casey's section 4, including the species with the elytra obliquely prolonged. This species is less shining than *hayi*. The elytra are more tapering and the pronotum is very differently formed.

Acanthoderes galapagonesis vonhageni, new variety

This variety differs from the type species as follows: the male in having the semi-erect hairs on the elytra longer and more conspicuous (scarcely visible in the type species); the outer apical angle of each elytron not so strongly produced; and the black markings on the elytra slightly different. The female specimen is badly rubbed so that the markings do not show plainly but, like the male, the outer apical angles of the elytra are not so strongly produced.

Holotype, male, and allotype, female, collected by Dr. Wolfgang von Hagen on Indefatigable Island, "Ecological Zone C," October 21, 1935.

These specimens were compared with Linell's type of *A. galapagoensis* by Mr. W. S. Fisher of the U. S. National Museum, who pointed out the above differences. He also called my attention to the fact that the type species being from Chatham Island may be responsible for the slight differences. In my opinion the above differences are sufficient to consider the Indefatigable Island specimens as a variety.

Metachroma labrale Blair

This species was described by Blair, 1933, Ann. Mag. Nat. Hist., (10) XI, p. 484, from one example collected on James Island. The collection before me contains twelve specimens from Conway Bay, Indefatigable Island, collected March 16 to 22, 1935, by the Crocker Expedition and one specimen from the same island, October 20, 1935, collected by Dr. Wolfgang von Hagen.

Examples were submitted to Dr. Blair who identified them as belonging to the above species. The length of the type is given as 7 mm. The specimens in the series before me vary from 6 to 8 mm. in length.

Docema darwini Mutchler

Three specimens of this species were collected by the Crocker Expedition at Academy Bay, Indefatigable Island, March 25, 1935.

Pantomorus galapagoensis Linell

In my former paper, 1925, Zoologica, V, p. 230, I listed one male and two female specimens from Conway Bay, Indefatigable Island, as *P galapagoensis*. Since then I have submitted these with twenty other specimens from the same island to Mr. L. L. Buchanan of the National Museum. His reply states that none of these are identical with the Linell species, the type locality of which is Chatham Island. He believes that there may be two or possibly three forms represented. I have examined these specimens and agree with him that there are differences in the specimens collected in the different localities. One form is represented by a single specimen and another by four specimens. I am not herewith describing these as there is a possibility that a larger series may connect them with the species from Conway Bay which I am describing below and which is represented by a series of twenty-three specimens

Pantomorus conwayensis, new species

Black, shining, pubescence coarse, white, more or less scale-like. Head at base finely punctate; between the eyes and on rostrum rugosely punctured; a median longitudinal sulcus extends from the frontal V-shaped impression on the rostrum to a short distance behind the eyes; antennae with basal joint of funicle moderately short, next joint about one-half longer, remaining joints short, club ovate pointed at apex; pubescence coarse, sparse, excepting on club which is densely and more finely pubescent with a few longer hairs intermixed. Pronotum wider than long; pubescence more dense on sides than on disk; moderately densely finely punctate, alutaceous; disk behind the middle with a median, short, longitudinal, slightly impressed line. Elytra more than twice as long as the thorax, widest about the middle; apex somewhat suddenly narrowed; striate punctate, the punctures coarser and deeper basally, becoming smaller apically; intervals convex; pubescence more dense at sides and apex. Under surface moderately densely pubescent, that on the side pieces coarser and scale-like. Length, 5–11 mm.

The male and female differ in that the female is robust and quite convex while the male, although convex, is less so than the female. It therefore appears more elongate and slenderer than the female.

Holotype, male, collected by the Williams' Galapagos Expedition, April 1, 1923. Allotype collected by the Crocker Expedition, March 13, 1935. Nine male and ten female paratypes, collected by the Crocker Expedition, March 12–19, 1935, and two female paratypes collected by the Williams' Galapagos Expedition, April 1, 1923. All of the above are from Conway Bay, Indefatigable Island.

My previous paper in Zoologica, 1925, pp. 219–240, contained a list of the species which had been described and recorded from the Galapagos Archipelago to that date. Since that time several species have been added. Corrections have also been made in generic and specific names. Notes referring to these corrections have been embodied in the following, which to my knowledge represents a complete list of species of Coleoptera accredited to the Galapagos fauna from 1925 to date.

Cicindelidae

Cicindela vonhageni, n. sp., p. 2.

Hydrophilidae

Enochrus waterhousi BLAIR, 1933, p. 473.
Enochrus obscurus BLAIR, 1933, p. 473.
Ochthebius batesoni BLAIR, 1933, p. 473.
Coelostoma darwini BLAIR, 1933, p. 474.

Histeridae

Saprinus batesoni BLAIR, 1933, p. 475.

Lycidae

Calocladon testaceum GORHAM, 1881, 'Biol. Centr. Amer.,' Coleop., III (2), p. 28, Pl. II, fig. 20 Recorded by Blair, 1933, p. 476.

Cantharidae

Chauliognathus sulphureus WATERHOUSE, 1878, Trans. Ent. Soc. London, p. 331. Recorded by Blair, 1933, p. 476.

Cleridae

Pelonium longfeldae BLAIR, 1928, p. 677.

Oedemeridae

Oxacis pilosa CHAMPION, 1890, 'Biol. Centr. Amer.,' Coleop., IV (2), p. 156, Pl. VII, fig. 15. Recorded by Blair, 1928, p. 673.
Alloxacis collenetti BLAIR, 1928, p. 477.

Meloidae

Cissites maculata Swederus, 1787, Vetensk. Acad. nya Handl., p. 199, Pl. viii, fig. 8. See p. 4.

Elateridae

Physorhinus sp.? Blair, 1928, p. 477.
Anchastus quirsfeldi, n. sp., p. 4.
Aeolus fuscatus Steinhal, 1875, 'Coleop. Hefte,' XIV, p. 125. See p. 4.

Temnochilidae

Temnochila galapagoensis, n. sp., p. 5.

Languriidae

Camptocarpus longicollis Motschulsky, 1860, in Schrenk 'Reisen Annurl.,' II (2), p. 244. Recorded by Blair, 1933, p. 476.

Coccinellidae

Cycloneda sanguinea Linnaeus, 1763, 'Centurea Ins.,' p. 10, 11. See p. 7.
Olla abdominalis Say, 1824, Jour. Acad. Nat. Sci. Philadelphia, IV, p. 95. See p. 7.

Alleculidae

Ctesia pedenoides Maklin, 1875, Acta. Soc. Fenuica, X, p. 681. Recorded by Blair, 1933, p. 480.

Tenebrionidae

Stomium. In the previous list I recorded four species belonging in this genus. The genus was revised by Blair, 1933, pp. 477–478, who recognizes the following species:
S. galapagoense Geo. R. Waterhouse with *S. carinipenne* Linell (spelled *carinatipenne* by Blair) as the male and *S. piceum* Linell as the female synonyms.
S. holopoides Geo. R. Waterhouse.
S. laevigatum ? = *S. baueri* Linell.
S. linelli is described as a new species, p. 478 = *laevigatum* Linell (not Geo. R. Waterhouse). He also, p. 477, lists this species as *mutchleri* but the description fixes *linelli* as the name.
Pedoneces lugubris Boheman, 1858, Eugen. Resa, Zool. II, Insecta I, p. 91, Pl. i, fig. 5. Recorded by Blair, 1933, p. 479.
Pedoneces batesoni Blair, 1933, p. 479.
Rhacius costipennis Blair, 1933, p. 480.

Anobiidae

Trichodesma denticollis Blair, 1928, p. 675.
Thaptor galapagoensis Blair, 1928, p. 676.
Eupactus georgicus Blair, 1928, p. 676.
Eupactus alutaceus Blair, 1928, p. 677.

Bostrichidae

Tetrapriocera tridens FABRICIUS, 1792, 'Ent. Syst.,' I (2), p. 652. *T. longicornis* Olivier, listed in my former paper, is a synonym of *tridens*.

The form listed by me in 1925 as *Amphicerus cornutus galapaganus* Lesne is listed by Blair, 1933, p. 476, as *Schistocerus galapaganus* Lesne.

Scarabaeidae

Ataenius cribrithorax BATES, 1887, 'Biol. Centr. Amer.,' Coleop., II, 2, p. 95. Listed by Blair, 1933, p. 476.

Ataenius arrowi HINTON, 1936. This species is apparently all or part of the series of thirteen examples listed by Blair as *A. cribrithorax* Bates. They are from the same locality, James Island, and part of the collection made by Bateson. Hinton in his remarks also refers to the specimens as bearing the label "*Ataenius cribrithorax* var." in Dr. Van Dyke's handwriting.

Neoryctes linelli, n. sp. See pp. 9 and 10 for remarks on this species and *N. galapa-*

Cerambycidae

Stenodontes (*Mallodon*) *galapagoensis*, n. sp., p. 11.

Eburia proletaria ERICHSON, 1847, Arch. fur Naturgsch., XII, 1, p. 140. Recorded by Blair, 1933, p. 481.

Compsa apicalis BLAIR, 1933, p. 481.

Monochammus hayi, n. sp., p. 13.

Acanthoderes galapagoensis var. *vonhageni*, n. var.

Estola galapagoensis BLAIR, 1933, p. 482.

Estola cribrata BLAIR, 1933, p. 483.

Estola insularis BLAIR, 1933, p. 483.

Chrysomelidae

Metachroma labrale BLAIR, 1933, p. 484.

Doryphora guerini STAL, 1857, Afr. Vet.-Akad. Farb., XIV, p. 54. Listed by Blair, 1933, p. 484 as *guerini* variety with note on differences between the Galapagos form and the typical.

Diabrotica ventricosa JACOBY, 1887, 'Biol. Centr. Amer.,' Coleop., VII, p. 543, Pl. XXXII, fig. 25. Recorded by Blair, 1933, p. 485.

Physonota alutacea BOHEMAN, 1854, 'Monog. Cassididarium,' II, p. 191. Recorded by Blair, 1933, p. 485.

Mylabridae

Spermophagus galapagoensis BLAIR, 1933, p. 678.

Bruchus fuscomaculata BLAIR, 1933, p. 679.

Curculionidae

Pantomorus conwayensis, n. sp., p. 15.

Geraeus batesoni BLAIR, 1933, p. 485.

Dryotribus mimeticus HORN, 1873, Proc. Amer. Philos. Soc., XII, p. 433. Recorded by Blair, 1933, p. 486.

Scolytidae

Pycnarthrum insulare Blair, 1933, p. 487.

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1933, ibid., XI, pp. 471–486. 'Further Coleoptera from the Galapagos Archipelago.'

Hinton, 1936, Ann. Mag. Nat. Hist., (10), XVII, pp. 416–418.

The authors and bibliographic references to the species recorded but not described by Blair are referred to under the headings of the respective species.

AMERICAN MUSEUM NOVITATES

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 18

TWO NEW MURIDAE FROM THE WESTERN DIVISION OF PAPUA

BY G. H. H. TATE AND RICHARD ARCHBOLD

Among the 1500 mammals obtained by the 1936 Expedition to western Papua the two species described below were recognized in the field as outstandingly different from any species described in New Guinea hitherto. The *Conilurus* represents an extension of a Torresian species-group into Papua; the *Leptomys* is a lowland member of a Papuan genus of Hydromyinae, previously unrecorded below 1000 feet. *Conilurus* is a denizen of the Ti-tree plains, *Leptomys* of well-drained forests bordering the north banks of the Fly River, 150 miles from its mouth.

Conilurus randi, new species

TYPE.—No. 105636, Amer. Mus. Nat. Hist.; ♀, old adult; Penzara, between Wassi Kussa and Morehead River, Western Division, Papua; alt. 20 meters; Dec. 16, 1936; collector, A. L. Rand, 1936 New Guinea Expedition. The type is a skin with terminal portion of tail missing, skull in good condition.

GENERAL CHARACTERS.—A member of that group of *Conilurus* to which *penicillatus*, *hemileucurus* and *melibeus* belong; not closely related to *C. albipes* of the southern part of Australia.

DESCRIPTION.—General color dorsally light grayish brown,[1] finely lined with fuscous; sides pale gray; underparts white, self-colored. The brown of the crown and rump slightly accentuated. Face and limbs gray; ears and tail grayish fuscous; tail becoming increasingly darker distally; hands and feet dull white. Eyes large; feet elongate; mammae 0–2 = 4; vibrissae attaining at most 60 mm.

Skull with the characters of the genus: strongly arched profile; broad zygomatic plate; sharp supraorbital edges; enlarged lacrimals; elongate palatal foramina; broad molar teeth; and deep mandible with greatly reduced coronary process.

Conilurus randi together with the previously known northern races differs from the southern *C. albipes* in possessing normal-sized instead of very large ears; a thinly-haired instead of densely woolly-haired tail; narrow palatal foramina; wide zygomatic plate; lack of thickening of maxillary root of zygoma; unwidened mastoid region.

From its nearest allies of northern Australia it is distinguished by its greater size; much broader and deeper muzzle and broader nasals; much longer and broader anterior palatal foramina; much broader mesopterygoid fossa; longer audital bulla; and larger molars.

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[1] Colors are those of Ridgway, 1912, 'Color Standards and Nomenclature,' only if capitalized.

MEASUREMENTS[1] OF TYPE.—Head and body, 193 mm.; tail (incomplete), 171; hind foot (s.u.) 48, (c.u.) 51; ear from crown, 22. Skull: greatest length, 47.2; condylo-incisive length, 43.9; basal length, 41.0; zygomatic width, 24.4; interorbital width, 6.8; width of braincase, 18.1; mastoid width, 14.8; nasals, 17.8 × 5.7; depth of muzzle behind incisors, 9.5; width of muzzle, 7.5; diastema, 12.6; palatal length 25.4; anterior palatal foramina, 11.1 × 3.2; width of mesopterygoid fossa, 3.6; length of bulla, 7.3; length of crowns of m^{1-3}, 9.0; width of m^1, 3.1.

Conilurus randi is of special interest not only as a new species but also because it marks the first record of a hitherto characteristically Australian genus in southern New Guinea.

We take pleasure in naming the new species for Dr. A. L. Rand who had charge of the field work of the 1936 Expedition to Papua.

Leptomys signatus, new species

TYPE.—No. 105792, Amer. Mus. Nat. Hist.; ♀, ad.; Sturt Island Camp, Fly River (n. bank), near Fairfax Islands, Western Division, Papua; sea level; October 12, 1936; collector, G. H. H. Tate, 1936 New Guinea Expedition. The type is a skin with skull, in good condition.

GENERAL CHARACTERS.—A grayish-brown *Leptomys* with large white frontal patch on each of the four specimens secured. Size rather smaller than *L. elegans* or *L. ernstmayri*.

DESCRIPTION OF TYPE.—Dorsal color nearest Verona Brown, with slightly darker shade above the middle of the back; underparts dull white, self-colored, reaching the wrists and ankles; hands and feet white; a large white area on frons, 13 mm. in length × 7.5 mm. in width. Ears fuscous; tail fuscous above, paler beneath, with white mottlings on distal half.

Pelage short (6 mm. on back; in *L. ernstmayri* it may reach 8 mm.); width of hind foot at base of fifth metatarsal 4.7 mm.; tail scales 14 per cm.; scale hairs 3 per scale, the hairs approximately one scale-length; mammae 0–2 = 4.

Skull slender, with large braincase and almost no flare of the squamosal root of the zygoma. Practically indistinguishable from that of A. M. No. 104199 and A. M. No. 104200 from Mafulu, which show no trace of the white brow area and were earlier referred to *L. ernstmayri*. Teeth of *signatus* much larger than those of the type of *ernstmayri* which was studied a few months ago. From *L. elegans* (also studied) the present species distinguishable by its frontal mark, much smaller size and larger teeth.

MEASUREMENTS.—Head and body (in the flesh), 144 mm.; tail, 151; hind foot (s.u.) 38; ear from crown, 19. Skull: greatest length, 38.4; condylo-basal length, 36.0; basal length, 32.9; zygomatic breadth, 16.2; interorbital breadth, 6.2; interparietal, 9.7; width of braincase, 14.7; width across mastoid, 13.5; palatal length, 20.0; palatal foramina, 4.8 × 2.4; length bulla, 4.8; length crowns m^{1-3}, 6.3; crown of m^1, 3.5 × 1.7; length mandible, 20.4.

This striking new form of *Leptomys* is represented by four specimens, all females and all from the same locality.

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[1] Skin measurements taken in the field.

AMERICAN MUSEUM NOVITATES

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BEES FROM PRINCE ALBERT PARK, SASKATCHEWAN

BY T. D. A. COCKERELL

In Novitates No. 909 (February, 1937) I recorded seven species of bees taken in Prince Albert Park in 1936. The present paper completes the account of the bees taken that year in the Park. The types of the new species will be found in the American Museum. From the nature of the country, a large bee-fauna is not to be expected, but I have no doubt that many species would be added by collecting in late spring and early summer.

Bombus terricola Kirby

1.—Hair of face all black. Workers from Lake Ajawaan, Aug. 26 (W. P. Cockerell); Lake Waskesiu, at beginning of portage to Heart Lakes, Aug. 31 (T. D. A. and W. P. Cockerell).

2.—Clypeus with much light hair. Workers from Lake Ajawaan, Aug. 25, and Saskatoon, Sept. 6. The latter, taken by Professor K. King, is not from the Park.

Bombus vagans Smith

Lake Ajawaan, Aug. 26 and 27, workers with a large patch of black hair on thorax above, agreeing with *B. consimilis* Cresson, considered to be a synonym of *B. vagans*. With these goes a small male from the north island in the middle of Crean Lake, at flowers of *Senecio*. This has the hind part of mesothorax with black hair, but none on scutellum; the third tergite has the hair entirely black.

A very different variety of the male was taken at Lake Ajawaan, Aug. 25. It has the hair of third tergite mixed yellow and black, and the hair of thoracic dorsum is entirely bright canary yellow, with no trace of black.

I have examined the genitalia of the two different forms of males, and they agree with *B. vagans*. In the variety with entirely yellow hair on dorsum of thorax the genitalia are larger and more robust. This form, having dull white hair on sixth tergite, approaches variety *helenae* Frison, and should perhaps be referred to that variety. It looks like a distinct subspecies, but Frison says that *helenae* occurs in the same nests with typical *vagans*.

Hylaeus ellipticus (Kirby)

Lake Ajawaan, Aug. 27, one female at flowers of *Solidago*. This is the form, assumed to be a variety of *H. ellipticus*, which has the clypeus all black, the tubercles cream-color, but upper border of prothorax all black, tegulae without light spots, wings strongly reddened. For a discussion of the variation of *H. ellipticus* see Novitates No. 490, p. 4.

Halictus provancheri Dalla Torre

Lake Waskesiu, at beginning of portage to Heart Lakes, Aug. 31, female (T. D. A. and W. P. Cockerell).

Halictus (Chloralictus) subconnexus Ellis

Lake Ajawaan, Aug. 27, male, at flowers of *Solidago*. The female of this species was taken by K. King at Saskatoon, Sept. 6.

Halictus (Chloralictus) subviridatus, new species

FEMALE.—Length about 5.5 mm., anterior wing 4.7 mm.; head and thorax dark blue-green, the clypeus somewhat yellower; legs black; abdomen very broad, highly polished, pure black; mandibles and antennae black; tegulae very dark brown; wings grayish hyaline; stigma very pale with a strong dark margin, nervures very pale; pubescence scanty, dull whitish, very faintly yellowish on inner side of tarsi. Head large, approximately circular seen from in front, the clypeus not strongly produced, shining, sparsely punctured, with the lower margin black; supraclypeal area shining on disc, front dull; mesothorax dullish, but conspicuously shining mesad of the notauli; scutellum shining, yellower than mesothorax; area of metathorax large, well defined, with strong regular plicae reaching the margin, which is not polished; abdomen with thin inconspicuous hair on apical corners of tergites, and conspicuous white hair at apex. Microscopical characters: front very densely punctured; punctures of mesothorax not so dense, on a minutely sculptured ground; tegulae not punctured; hind spur with about four long oblique spines; abdomen with excessively minute widely scattered punctures.

MALE.—Face narrowed below, with thin white hair; antennae very long, the flagellum reddish clay-colored below except apically; tegulae with a large light red spot; stigma dark brown; nervures brown, much darker than in female; area of metathorax coarsely sculptured; legs entirely dark; abdomen shining black, rather short and robust for a male.

Saskatchewan: Lake Ajawaan, 1936 (Cockerell). The female Aug. 26, the male Aug. 27, at flowers of *Solidago*. The female is the type; I am not sure that the male is conspecific. The female falls close to *H. viridatus* Lovell, which has a dull mesothorax, and much less polished, browner abdomen. It is even nearer to *H. viridatulus* Ckll., from the mountains of Colorado, and seen from in front appears to be that species, but the wings and the less hairy abdomen are distinctive. The striae on lower part of front are oblique, not transverse. Among the species described by Mrs. Ellis it falls nearest to *H. zophops*, which is much larger, with a much larger stigma. The male goes in the Sandhouse table to *H. praepes* Ellis, from the mountains of Colorado, but differs by the strongly punctured clypeus, and very distinctly though sparsely punctured scutellum.

Halictus (Chloralictus) rufulipes, new species

Female.—Length about 5.8 mm., anterior wing 4 mm.; head and thorax dark bluish green, with scanty whitish hair; legs black, with the knees narrowly red, and the tarsi red, the middle and hind basitarsi somewhat infuscated; abdomen shining black, the margins of the tergites not discolored. Head broad; mandibles red except at base; flagellum chestnut-red beneath; clypeus well punctured, its lower half black; supraclypeal area prominent, with a brassy tint; front dull; mesothorax moderately shining but not polished, very finely punctured, the median groove very strong; scutellum shining, with a median depression; area of metathorax very large, coarsely plicate and wrinkled all over; posterior truncation shining, sharply defined at sides; tegulae very dark in front, with a clear reddish boss behind; wings dusky; stigma very large, dull fulvous, with no dark margin; nervures very pale fulvous; second cubital cell higher than broad, receiving recurrent nervure very near end; third cubital cell much wider on marginal than second; abdomen shining, very minutely punctured, the hair thin and inconspicuous, thinly covering disc of fourth tergite. Microscopic characters: front excessively densely punctured, not striate; mesothorax with well-separated punctures on a tessellate surface; area of metathorax with well-defined plicae at sides, the intervals cross-striate, but in the middle the sculpture is irregular and confused; hind spur with four oblique spines; first tergite practically impunctate.

Saskatchewan: Lake Waskesiu, at the beginning of the portage to Heart Lakes, Aug. 31, 1936 (T. D. A. and W. P. Cockerell). In my manuscript table this runs to *H. viridatus* Lovell, which has a broader, darker thorax, and dark tarsi. In the Sandhouse table it runs to 55, and falls near *H. ruidosensis* Ckll., from which it differs in the metathorax and other characters. Although the abdomen is described as black, in a strong oblique light the basal part of the fourth tergite and the apical part of the third have a distinctly greenish appearance.

Halictus (Chloralictus) brevibasis, new species

Male.—Length about 5.5 mm., anterior wing 4.3 mm.; rather slender, with subclavate abdomen; head and thorax very dark greenish, the cheeks, sides of thorax, and metathorax, black; mandibles black; flagellum very long, obscure brown beneath; head broad, circular seen from in front, the clypeus moderately produced, its marginal region black; face contracted below, it and sides of front covered with white hair; mesothorax dull, finely punctured; scutellum shining on disc, with a median depression; area of metathorax remarkably short, with strong regular plicae on basal half only, the apical margin swollen and shining; posterior truncation sharply bordered, only moderately shining, with a deep median sulcus; tegulae shining black; wings dusky; stigma dusky reddish brown, nervures brown; third cubital cell very broad above; legs black, with white pubescence, abundant on hind tibiae; abdomen highly polished, without bands or spots of hair; there is a large and conspicuous tuft of white hair on each side of venter near apex, on the margin of fifth sternite. The microscope shows that the mesothorax has well-separated punctures on a tessellate surface.

Saskatchewan: Lake Waskesiu, at the beginning of the portage to Heart Lakes, Aug. 31, 1936 (T. D. A. and W. P. Cockerell). This cannot be the male of *H. rufulipes*, on account of the dark tarsi, stigma and nervures. In my table it falls near *H. ruidosensis* Ckll., differing conspicuously in the metathorax and wings. In the Sandhouse table it falls in the vicinity of *H. abundus* Sandhouse, *H. tranquillus* Sandhouse and *H. pudicus* Sandhouse. *H. abundus* is very different by the large, coarsely sculptured area of metathorax. The dark tarsi and other characters separate our species from *H. tranquillus* and *H. pudicus*. In Robertson's table it falls near *H. obscurus* Rob., but the wings are quite different.

AMERICAN MUSEUM NOVITATES

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A LARGE *TENTACULITES* FROM THE SHRIVER FORMATION (ORISKANY) OF PENNSYLVANIA

BY H. E. VOKES

The species of large *Tentaculites*, here described, occurs in a fauna recently added to the collections of The American Museum of Natural History from the Phillip's Clay Quarry, three miles southeast of Alexandria in Huntington County, Pennsylvania. The fossils occur in a soft, siliceous white clay member of the Shriver formation.

The most striking elements in the fauna are large trilobites referable to the genus *Dalmanites*. These will be discussed at a future time.

Other forms noted include:

Anoplotheca flabellites (Conrad)
Schuchertella becraftensis (Clarke)
Chonetes hudsonicus Clarke
Stropheodonta cf. *oriskania* Clarke
cf. *Diaphorostoma desmatum* Clarke

F. M. Swartz,[1] has made extensive studies of the stratigraphy of the Lower Devonian of West Virginia and Virginia, and has concluded (p. 48) "that the Shriver chert and the Becraft limestone of Maryland and the Virginias are at least essentially equivalent in time. As has been shown in the discussion of the Becraft, however, the limestones referred to that formation in Maryland and Virginia seem to range higher than the top of the type Becraft in New York, the upper portion probably being at least as young as the Port Ewen limestone of southeastern New York and New Jersey." Thus, the Shriver formation tends to straddle the boundary between the Helderberg and Oriskany groups of the New York section. On the basis of lithology, and of faunal affinities, it has been referred to the Oriskany group.

I take great pleasure in naming this species in honor of Dr. Chester A. Reeds, former Curator of the Department of Geology and Invertebrate Palaeontology of The American Museum of Natural History, who collected the specimens here described.

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[1] 1929, U. S. Geol. Survey, Prof. Paper 158-c, pp. 25–75. See especially pp. 47–48.

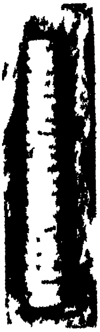
Tentaculites reedsi, new species

Figures 1, 2, 3

Holotype.—A.M.N.H. No. 24981; length (incomplete) 35.5 mm.; greatest diameter 6.0 mm.; least diameter 4.4 mm.

Paratype.—A.M.N.H. No. 24982; length (incomplete) 49.0 mm.; greatest diameter (somewhat crushed) 5.6 mm.; least diameter 1.0 mm.

Three specimens are in the collection, two incomplete apically, but with the shell structure preserved; the third, an internal cast, somewhat crushed and fragmented, but complete almost to the apex. Together they indicate a length in excess of 70 mm. for this species. The shell is elongate, relatively thick, cylindrical in section and very gradually tapering to the apex, which may have been slightly curved. The surface is ornamented by strong annulations, which are sharply rounded apically, and slope inwardly toward the aperture giving the appearance of a series of invaginated cones. There are six such annulations within ten millimeters on the apertural portion of the holotype, and seven on the apical end. The presence of the annulations is well shown on the apertural por-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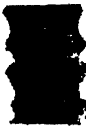
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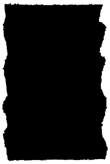
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Fig. 1. *Tentaculites reedsi*, n. sp. Holotype, A.M.N.H. No. 24981 (× 1).

Fig. 2. *Tentaculites reedsi*, n. sp. Paratype, A.M.N.H. No. 24982 (× 1).

Fig. 3. *Tentaculites reedsi*, n. sp. Portion of surface of holotype enlarged (× 3).

Fig. 4. *Tentaculites elongatus* Hall. Syntype, A.M.N.H. No. 2590/3 (Hall collection). Portion of surface enlarged (× 3).

Fig. 5. *Tentaculites elongatus* Hall. Syntype, A.M.N.H. No. 2590/3 (Hall collection) (× 1). This is the specimen represented in Pl. vi, fig. 16 of Nat. Hist. N. Y., Palaeontology, III, 1859.

tion of the paratype, but tend to become sub-obsolete apically, that area of the cast being almost smooth. Annulations, however, appear to have been present, but were small and were closely approximate. On the sloping surfaces of the annulations are three to five, generally three, low rounded riblets. These do not appear to be simple growth lamellae, but seem to be definite features of ornamentation.

This species resembles *Tentaculites elongatus* Hall[1] in size and general appearance, but may be distinguished from that form by the details of the surface of the shell. The annulations on the latter species are sharply delimited aperturally as well as on the apical slope, forming relatively sharp ridges around the shell. As a result they tend to appear higher, more prominent, and more closely approximate. The whole surface of shell, both between and on the annulations, is marked by numerous fine, raised growth lamellae, and there is no evidence of any additional ornamentation.

ADDITIONAL NOTES ON *TENTACULITES ELONGATUS* HALL

There are three specimens of this species among the types in the Hall collection in The American Museum of Natural History. They are labeled by R. P. Whitfield, as representing figures 16, 17 and 20, and 21 of the original illustrations. The first two are correctly labeled; the latter does not appear to be that represented in figures 20 and 21. It is a more complete specimen with the shell preserved over much of the surface, and lacks the smooth apical area indicated in the figure. The specimen shown in figures 18 and 19 is in the collection of the New York State Museum at Albany (No. 5281/1). The specimen shown in figure 16 of Plate VI (A.M.N.H. No. 2590/3, Hall collection) is here figured (Figs. 4, 5). It is in a gray shaley limestone, and the label indicates that it came from "The Helderbergs." The other specimens are from Schoharie.

Figure 18, of the original illustrations, shows the anterior end to be lacking the shell. The outline of this area seems to have the same relative shape as the exterior, with sharp annulations and relatively parallel-sided inter-annulate areas. Figures 20 and 21, however, show an outline similar to that of paratype No. 24982, and the specimen there illustrated may well represent our species. However, Clarke in his memoir on 'The Oriskany fauna of Becraft Mountain, Columbia County, N. Y.'[2] shows specimens with an external outline and ornamentation of *T. elongatus*, and an internal cast with a shape suggestive of *T. reedsi*, and of Hall's figures 20 and 21.

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[1] 1859, Nat. Hist. N. Y., Palaeontology, III, p. 136, Pl. VI, figs. 16–21.
[2] N. Y. State Mus. Mem. 3, Pl. III, figs. 8–12. (See especially Fig. 9.)

T. arenosus Hall[1] is based on an internal cast with a similar outline. The original illustrations are quite defective, and an examination of the holotype (A.M.N.H., No. 2699/1) shows that the last six annulations possess the sharp outline of those of *T. elongatus*. On this basis, *T. arenosus* is here considered to be a synonym of the former species, as suggested by Hall in the original description.

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[1] 1879, Nat. Hist. N. Y., Palaeontology, V, pt. 2, p. 166, Pl. xxxi, figs. 1, 2.

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NEW METOPIIDAE AND TACHINIDAE FROM AFRICA (DIPTERA)

By C. H. Curran

Descriptions of the species included in this paper are presented at this time in order that the names may be available for studies on the biology of the species. Unless otherwise stated the types are in The American Museum of Natural History. At least paratypes of all the species are deposited in this institution.

Metopiidae

Calliphora insignis, new species

Distinguished from *flavicauda* by the wider front of the male and the much finer frontal bristles of the female. Length, 8 to 11 mm.

Male.—Head blackish, cinereous pollinose, the pollen on the parafacials and parafrontals silvery and tessellate. Front wider than the ocellar triangle, with about eight pairs of fine frontals and many bristly hairs; ocellars long. Frontal vitta brown, obsolete for a short distance in front of the ocelli. Pile black, yellowish below the neck. Parafacials with black hair above; facial ridges with fine bristles on more than the lower half. Palpi and antennae blackish. Eyes bare.

Thorax blackish, the dorsum with bronze reflection and with rather thick cinereous pollen in front, the posterior third and pleura less densely pollinose, the five dark vittae narrow and limited to the presutural area except for obscure spots near the middle of the posterior half. Acrosticals 2–3; dorsocentrals 3–3; sternopleurals 2–1. Disc of scutellum thinly pollinose; four pairs of marginals and one pair of discals. Hair wholly black. Anterior spiracle reddish brown.

Legs dark brown, with black hair.

Wings cinereous hyaline, the base more or less broadly pale brownish. Squamae brown with whitish border and fringe, the discal hair brown. Halteres yellow.

Abdomen metallic purplish blue, the apices of the segments darker, the basal half or more cinereous or cinereous white pollinose; apex of fourth segment rather narrowly yellow. Third and fourth segments with row of marginals, the fourth with irregularly placed discals. Hair wholly black.

Female.—Front not as wide as one eye; eight or nine pairs of rather fine frontals, the upper pair stronger and divaricate-reclinate; apex of fourth segment rarely only obscurely yellow.

Types.—Holotype, male, and allotype, female, Buaea, Nigeria, in Deutsches Entomologisches Institut. Paratypes, thirteen males and seven females, Mt. Cameroon, Nigeria (F. Zumpt).

Strongyloneura cuthbertsoni, new species

Green, the middle of the abdomen bronzed above in male, mostly cupreous in female; wings brown on apical third. Length, 7 to 8 mm.

MALE.—Head black in ground color, densely grayish pollinose, a large spot below the middle of the parafacials and the anterior two-fifths of the cheeks shining black. Eyes separated by a distance almost as great as the width of the ocellar triangle. About seven pairs of frontals and a few bristly hairs above them. Ocellars long and strong; postocellars well developed; outer verticals absent. Cheeks almost one-third as wide as the eye-height, with rather fine black hair. Parafacials wide, with a few short black hairs on the inner half. Palpi reddish. Antennae black, the third segment brown or brownish red; arista with long black rays.

Thorax bright green, with thin cinereous ochraceous pollen. Acrosticals 2–3, the anterior pair rather short; dorsocentrals 2–4; sternopleurals 1–1; three pairs of marginal scutellars and a pair of discals. Hair black, mostly yellow on the sternopleura and on the pteropleura.

Legs black or dark brown; middle tibiae with a single anterodorsal bristle.

Wings very pale brownish, with the costal border broadly, and the apical third except on the broad posterior border, brown; apical cloud distinctly separated from the dark costal border beyond the tip of the first vein. Squamae yellowish brown, the bases yellow. Halteres yellow.

Abdomen bright green on the sides and with cupreous genitalia. Along the broad middle line above and below, thoroughly bronzed, the bronze color spreading out on the posterior half of the segments to form wide, incomplete fasciae. The dorsum of the abdomen is thickly covered with cinereous pollen which, from posterior view, wholly conceals the ground color. The marginal bristles on the segments are weak and appressed on the dorsum of all but the last segment, becoming long at the sides. Second genital segment large and prominent and bearing many bristles. Abdominal hair black, only the first and second sternites bearing whitish pile.

FEMALE.—Front half as wide as one eye, the parafrontals shining black, with a large spot of sericeous pollen on each side at the lower third, a small orbital spot of yellowish near the middle and another spot above the upper proclinate bristle. Outer verticals more than half as long as the verticals; parafacial hairs very inconspicuous. Squamae white, the lower lobe with slight grayish tinge. Abdomen mostly cupreous, with a narrow, dark median vitta on the basal half; marginal bristles on third segment erect.

TYPES.—Holotype, male, and allotype, female, Vumba Mountains, Southern Rhodesia, March, 1935 (A. Cuthbertson). Paratype, male, Vumba Mountains, January 18, 1935 (Major Drysdale).

This species is closely related to *terminata* Wiedemann but is very distinct. The eyes are more widely separated and the parafrontals less thickly pollinose; the bristles on the genitalia are more numerous and most of them are longer; the outer forceps are not recurved and the posterior forceps not reddish and contorted. In *terminata* there are only a few pale hairs on the pteropleura. Both *distinguenda* Villeneuve and *nigrohirta* Malloch have the thorax wholly black-haired.

Strongyloneura sheppardi, new species

Bright green, the abdomen densely grayish pollinose and without trace of median dark vitta; wings only very slightly darkened apically. Length, 9 mm.

MALE.— Middle of face reddish or yellowish, the cheeks mostly reddish on the anterior half; head otherwise black in ground color and with cinereous white pollen, the occiput with ashy pollen. Front at narrowest part distinctly wider than the ocellar triangle; nine or ten pairs of frontals, the upper one or two hair-like. Ocellars long; postocellars not developed; outer verticals absent. Cheeks more than one-third the eye-height, wholly pollinose and pale yellowish or white pilose. Parafacials with a few microscopic, scatterd hairs. Palpi reddish. Antennae reddish, the third segment brown on upper half or less.

Thorax bright green, rather thinly yellowish cinereous pollinose above and with whitish pollen on the sides and on the anterior slopes of the mesonotum. Chaetotaxy as in *cuthbertsoni.* Hair black, pale yellow on the pleura, with the exception of the mesopleura, where it is coarse and black.

Legs black, the tibiae and most of the first segment of the tarsi, reddish.

Wings with luteous tinge, the apex broadly cinereous, the base yellowish; second vein slightly clouded with yellowish brown on the apical half. Squamae white with the rim more or less yellow. Halteres yellow.

Abdomen so densely grayish pollinose as to conceal the ground color, except laterally where it is green basally but becomes bronzed on the apical segments. Second genital segment rather small, bronzed or blackish, the first blue-green. Hair black, yellow on the basal three sternites, the apices of the second and third with black bristly hairs apically. Marginal bristles very weak and appressed except on the sides and on the fourth tergite; a row of discals on the apical third of the fourth segment.

FEMALE.—Front a little more than half as wide as one eye, cinereous pollinose; abdomen with slightly thinner pollen; fourth segment with a row of discals across the middle or slightly behind this point.

TYPES.—Holotype, male, and allotype, female, Balla Balla, Southern Rhodesia, March, 1931 (A. Cuthbertson). Paratypes: female, Balla Balla, April, 1933 (Cuthbertson); male, Umtali District, Southern Rhodesia, November 26, 1931 (P. A. Sheppard).

This species is close to *dubiosa* Villeneuve but the widely separated eyes of the male are distinctive and the pollen of the head has no yellow tinge; there are fewer hairs on the parafacials and they are darker. Almost all specimens of *dubiosa* have the mesopleura wholly pale-haired, a character that is apparently not found in *sheppardi.*

Strongyloneura darwini, new species

Green, the ground color partly concealed by pale pollen; face with bare spot on each side below; basicosta brown; antennae wholly reddish. Length, 10 mm.

MALE.—Head black in ground color, the middle of the face and the soft part separating face and cheeks reddish; pollen cinereous; a large spot on each side of the parafacials below the middle and almost the anterior third of the cheeks bare. Eyes separated by less than the width of the ocellar triangle; eight or nine pairs of frontals and a few scattered hairs outside them; ocellars long, the postocellars slightly developed. Outer verticals absent. Cheeks a little more than one-third the eye-height, with fine black hair. Parafacials wide, with short black hair on lower half and a few scattered hairs above. Palpi reddish. Antennae wholly reddish, reaching a little more than halfway to the vibrissae.

Thorax brightly green, moderately covered with cinereous or cinereous white pollen; a pair of weak, narrow cupreous dorsocentral vittae visible in some lights. Acrosticals 3–5 or 6, the chaetotaxy otherwise as in *cuthbertsoni*.

Legs black, the front femora sometimes mostly green.

Wings with luteous tinge, the costal border narrowly brownish. Squamae white. Halteres yellow.

Abdomen bright green on the sides and venter, the dorsum so thickly cinereous pollinose that the ground color is obscured. Fourth segment with discals on the apical third and on more than the apical half at the sides. Hair black, yellowish only on the first and basal half of the second sternite, the sternites blackish. Genitalia small, the basal segment green, the second black.

TYPES.—Holotype, male, Darwin, Southern Rhodesia, March, 1933. Paratypes, male, Darwin, March, 1933, and male, Salisbury, Southern Rhodesia, February 27, 1910.

This species somewhat resembles *griseoviridis* Bezzi but is larger and that species has the epaulet and basicosta reddish.

Tachinidae

EUTRIXINA, NEW GENUS

Very similar in structure to *Eutrixa* Couquillett of North America but with the apical cell moderately long petiolate and infrasquamal setulae absent.

Upper half of front linear in male, the frontal bristles confined to the anterior half, short and weak, all above the base of the antennae; no parafrontal hairs; ocellars little longer than the ocellar triangle; verticals very short. Frontal vitta linear except in front. Lower occiput swollen. Cheeks almost one-third the eye-height, chitinized on about the posterior half. Parafacials very narrow, bearing a row of very short hairs. Facial depression oval, moderately deep and with a low median carina, occupying about the upper half of the face, the middle of the face narrowed and receding below the depression. Oral margin bordered by a single row of weak bristles that extend along the facial ridges to slightly above the vibrissal angles. Proboscis short. Labellae large, produced posteriorly; palpi of normal length, gently clavate, haired on apical half. Antennae short, not reaching to the lower edge of the facial depression, the third segment not half longer than wide, its width about equal to the length of the second segment, its apex convex. Arista bare, swollen on the basal sixth. Eyes bare. Acrosticals 0–1; dorsocentrals 2–3; one sublateral and one supra-alar, no posthumeral; two sternopleurals; three pairs of marginal scutellars, the apical pair parallel; propleura and prosternum bare. Legs of normal length; each tibia with two posterior bristles, the hind tibiae with two anterodorsals. Pulvilli shorter than the last tarsal segment. A single bristle at the base of the third vein; no costal spine; petiole of apical cell from one-third to one-half as long as the apical crossvein; the posterior crossvein joins the apical cell nearer to the bend of the fourth vein than to the anterior crossvein. Squamae large, extending inward posteriorly. Abdomen elongate oval, gently tapering posteriorly. No dorsal bristles on the first two segments but rows of marginals on the last two, those on the third segment weak and appressed. First segment with a group of five laterals, the second with two lateral marginals. Genitalia small, transverse. Sternites fully exposed.

GENOTYPE.—*Eutrixina fasciata*, new species.

Eutrixina fasciata, new species

Yellowish, the thorax black in ground color. Length, 5.5 to 6.5 mm.

MALE.—Head rather reddish yellow in ground color, the occiput blackish except below; pollen white on face and front, cinereous on the occiput, the soft part of the cheeks brownish yellow, the lower section of the face shining brown on the upper part. Palpi reddish yellow, the proboscis brown. Antennae reddish, the third segment mostly and the arista, brown.

Humeri yellowish in ground color, thickly cinereous pollinose; mesonotum with four moderately wide blackish vittae, the outer pair broadly interrupted at the suture, the inner pair extending to only a little behind the middle.

Legs reddish, the front femora usually mostly brown, the others with very broad, usually incomplete preapical brown bands; tarsi brownish except basally.

Wings cinereous hyaline, the veins yellow basally. Squamae pale brownish, with whitish base and yellowish border. Halteres yellow.

Abdomen yellow, a narrow median vitta, the fourth segment and the narrow apices of the preceding three brown, wholly cinereous yellow pollinose, the pollen on the sides and venter thinner. Sternites pale orange, the genitalia reddish but partly stained with brown.

TYPES.—Holotype, male, Victoria, Southern Rhodesia, November, 1933 under *Acacia*. Paratypes: one male, same data; two males, Salisbury, Southern Rhodesia, November 30, 1935 and four males, Salisbury, January 28, 1936, swarming under a tree in late afternoon; all collected by Mr. A. Cuthbertson.

AFROVORIA, NEW GENUS

Related to *Catalinovoria* Townsend but readily distinguished by the second antennal segment being almost as long as the third.

Front somewhat wider than one eye, convex in profile, the parafrontals wider than the vitta except on the upper part; three to five pairs of proclinate orbitals; eight pairs of frontals, all more or less reclinate, the lowest situated opposite the base of the arista; a very few tiny black hairs on the parafrontals; ocellar triangle with short hairs; ocellars long and strong, proclinate-divaricate; outer verticals well developed in both sexes; occiput flat; cheeks about one-sixth as wide as the eye-height with a few bristly hairs on the lower half; parafacials wide above, rather strongly narrowing below; facial depression moderately deep, the oral margin only a little projecting. Palpi clavate, with short, appressed hairs. Antennae reaching almost to the vibrissae, the second segment two-thirds to almost as long as the third, the third with sub-parallel sides and sub-angular apex; arista thickened on the basal three-fourths, the second segment three or four times as long as wide. Eyes bare.

Infrasquamal setulae absent, the propleura and prosternum bare. Acrosticals and dorsocentrals 3–3; three intra-alars; posterior sub-lateral and posthumeral bristles present; three sternopleurals and marginal scutellars, the apical scutellars weak; two or three pairs of short discals on the scutellum.

Legs normal in length. Anterior tibiae with two posterior bristles, the middle ones with two strong anterodorsals, the hind tibiae not closely ciliate.

Wings with a strong fold at the bend of the fourth vein, the last section of the fifth vein more than three-fourths as long as the preceding section; first vein bristled on its whole length, the third to well beyond the anterior crossvein. Squamae large.

Abdomen sub-cylindrical, almost twice as long as wide, without discals; the hairs on the fourth segment very stout; first and second segments with median marginals, the third and fourth each with a row.

GENOTYPE.—*Afrovoria munroi*, new species.

Afrovoria munroi, new species

Black, with cinereous pollen. Length, 6.5 to 7.5 mm.

MALE.—Head densely white pollinose, the occiput cinereous; frontal vitta reddish brown. Palpi reddish. Antennae reddish with the third segment and arista black.

Thorax cinereous pollinose, with four blackish vittae, the median ones slender and widely separated, the outer ones broad and not interrupted at the suture. Hair black.

Legs black, with black hair.

Wings cinereous hyaline with luteous veins and yellowish base. Squamae white. Halteres yellow.

Abdomen black, the basal fourth of the second to fourth segments white pollinose. Genitalia small.

TYPES.—Holotype, male, allotype, female, and paratypes, three females, Barberton, Transvaal, February 5, 1927; five females, Barberton, February, 1927 and December 3, 1928, and two males and one female, without locality, January, 1927; male and four females, Warmbaths, Transvaal, February 16, 1920. The types are in the South African Museum.

AFROPLAGIA, NEW GENUS

Similar to *Afrovoria* with the following exceptions: eyes with moderately long whitish hair; facial ridges with strong bristles on more than the lower half; third antennal segment conspicuously longer than the elongate second; first vein bare; abdomen with discals on all but the first segment.

GENOTYPE.—*Afroplagia fasciata*, new species.

Afroplagia fasciata, new species

Black, the basal two antennal segments reddish brown; squamae white; halteres reddish with the base of the knob brown. Length, 6 to 8 mm.

MALE AND FEMALE.—Head white pollinose, the bristles and hair black, the occiput yellowish haired below the neck. Palpi reddish. Thorax with cinereous pollen, the vittae narrow and weak. Wings cinereous hyaline. Second to fourth abdominal segments each with the basal third to fourth cinereous white pollinose; first segment without marginals, the second and third each with two or three pairs of discals; hair on fourth segment all bristle-like.

TYPES.—Holotype, male, Wartburg, Natal, December 27, 1915; allotype, female, Wartburg, December 31, 1915. Paratypes, two females, Wartburg, September 1, 1916. Types in South African Museum.

PRETORIANA, NEW GENUS

Differs from *Campylochaeta* Rondani in having the proboscis long and slender and the male genitalia short. The characters of the genus are contained in the specific description.

GENOTYPE.—*Pretoriana setosa*, new species.

Pretoriana setosa, new species

Black, the basal antennal segments, palpi and halteres reddish; pollen cinereous white. Length, 9 to 10 mm.

MALE.—Front much wider than one eye, the parafrontals rather thinly pollinose, the frontal vitta brownish red. Eight or nine pairs of frontals, the upper two reclinate. Parafrontals with two irregular rows of bristles, the outer extending onto the parafacials; ocellars long and strong; outer verticals two-thirds as long as the verticals. Two or three rows of black hairs behind the eyes, the occiputal pile pale yellowish. Cheeks one-third as wide as the eye-height, with hairs on the lower half. Parafacials wider than the antennae, with bristly hairs on the upper half or more. Facial ridges with strong bristles on the lower three-fourths, the vibrissae long and strong. Palpi reddish, their hair short and sparse; second section of the proboscis shorter than the head-height. Antennae reaching almost to the oral margin, the third segment almost five times as long as the short second; the basal segments reddish; arista bare, thickened on almost its whole length.

Thorax moderately thickly pollinose, the mesonotum with four narrow dark vittae visible in some lights. Acrosticals 3–3; dorsocentrals 3–4; sternopleurals 2–1; three intra-alars, prealar long and strong; four pairs of marginal scutellars, the apical pair weak and decussate; four discal scutellars. Infrasquamal setulae absent; propleura bare; prosternum with two or three bristly hairs on each side.

Legs black; anterior tibiae with two posterior bristles and seven antero- and posterodorsals; middle tibiae with two strong and two weak anterodorsal bristles, two long posterodorsals and a strong ventral; posterior tibiae with eight or nine anterodorsals and two strong posterodorsals. Pulvilli short.

Wings cinereous hyaline, the apical cell closed or narrowly open well before the apex of the wing; posterior crossvein much nearer the bend of the fourth vein than to the anterior crossvein; third vein bristled halfway to the small crossvein; costal spine moderately short. Squamae white, moderately broad, rounded inwardly. Halteres reddish yellow.

Abdomen black, thinly cinereous pollinose, the apices of the segments dark, the fourth shining on almost the apical half; bases of second and third segments narrowly thickly pollinose. First and second segments with pair of median marginals, the third and fourth each with a row; second and third each with several discals, the fourth with two rows and with the hair all erect and bristle-like. Sternites mostly concealed. Genital opening narrow, the genitalia small.

FEMALE.—The outer row of parafrontal bristles is replaced by an irregular row of four proclinate orbitals on each side; genital opening slit-like.

TYPES.—Holotype and allotype, male and female, Pretoria, South Africa, November 10, 1917. Paratypes, five males and one female, Pretoria, January 25, 1914, October 5, 1914 and November 10, 1917 (H. K. Munro). Types in South African Museum.

AMERICAN MUSEUM NOVITATES

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXVIII[1]

ON A COLLECTION FROM ERROMANGA, NEW HEBRIDES

BY ERNST MAYR

Mr. L. Macmillan, who made such an auspicious start on Tanna Island,[2] continued his collecting activities in the southern New Hebrides with a thorough exploration of Erromanga Island. Our knowledge of the bird life of this island was restricted to mostly small collections made by Layard, Ramsay, Farquhar, Macgillivray, and Brenchley. The thoroughness of Macmillan's exploration is best illustrated by the fact that he obtained every species which had previously been recorded except two, *Charmosynopsis palmarum* and *Tyto alba*, both of which he only saw without being able to obtain specimens. He also added the following species to the list of Erromanga birds: *Puffinus tenuirostris*, *Puffinus lherminieri*, *Phaeton rubricauda*, *Demigretta sacra*, *Porphyrio albus*, *Urodynamis taitensis*, *Collocalia spodiopygia*, *Hirundo tahitica subfusca*, *Clytorhynchus pachycephaloides grisescens*, and *Zosterops lateralis*.

Although Erromanga is much nearer to Tanna than to Efate, it shares with Efate the following 4 species, which do not occur on Tanna: *Coracina caledonica*, *Clytorhynchus pachycephaloides*, *Pachycephala pectoralis*, and *Lichmera incana*. All four species occur again in New Caledonia, to the southwest of Tanna, and it will be interesting to investigate the zoogeographical significance of this irregular distribution.

A more detailed report on the birds of the New Hebrides is planned for the future and I shall content myself at the present time with discussing some of the more interesting species collected by Mr. Macmillan. His second shipment from Erromanga was unfortunately shipwrecked and a considerable portion of the material was badly damaged by water. The majority of the specimens is, however, in good condition. Mr. Macmillan deserves great credit for his excellent work.

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[1] Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, 947, and 977.

[2] See: 'On a collection from Tanna, New Hebrides,' Amer. Mus. Novit., No. 912, pp. 1–4 (1937).

Halcyon chloris erromangae, new subspecies

TYPE.—No. 447435, Amer. Mus. Nat. Hist.; ♀ ad.; Dillons Bay, Erromanga, New Hebrides; June 24, 1936; L. Macmillan.

About intermediate between *juliae*[1] (Efate) and *tannensis* (Tanna). The adult male differs from that of *juliae* by having the sides of the throat, breast, abdomen, flanks, under wing-coverts, and axillaries buffy or pale ochraceous, not white or pale buff; the ring-band and the collar are much deeper rust-colored; the upper parts are slightly more greenish. Differs from that of *tannensis* by the much paler coloration of under parts, under wing, ring-band, and collar.

The adult female differs from that of *juliae* by having the under wing-coverts buff, not white, and by having the lores, the superciliary stripe, and the ring-band deep rust-colored instead of white or buffy; most feathers of the forehead have narrow buffy edges; the general coloration of the upper parts is slightly lighter and greener with less black on the upper back. Differs from the female of *tannensis* by having the ear-coverts black tinged with green, instead of bluish green, and by the paler under wing-coverts.

Wing: 1 ♂ ad., 100; 3 ♂ imm., 92, 96, 96; 6 ♀ ad. (partly moulting), 97–100; 2 ♀ imm., 99, 99. Tail (to tip of longest tail-feather): ♂ ad., 71; ♂ imm., 63, 66, 68; ♀ ad., 67–72; ♀ imm., 66, 67. Bill (from nostril): ♂ ad., 36; ♂ imm., 35.5, 35.5, 36; ♀ ad., 35–38 (36.6); ♀ imm., 35, 35.5.

RANGE.—Erromanga Island, southern New Hebrides.

It is not at all surprising to find a form on Erromanga, an island between Tanna and Efate, which is intermediate in its characters between the widely differing *juliae* and *tannensis*. It is interesting, however, that the male resembles more that of the Efate form and the female that of the Tanna form. There is apparently no noticeable difference in size between the three forms.

Pachycephala pectoralis efatensis, new subspecies

TYPE.—No. 212746, Amer. Mus. Nat. Hist.; ♂ ad.; Efate Island, New Hebrides; June 14, 1926; R. H. Beck.

ADULT MALE.—Similar to that of *P. p. chlorura* (Erromanga) but back brighter, more citrine, less greenish; yellow nuchal band broader and more conspicuous; yellow of under parts deeper; black breast band broader; less gray on the outer webs of the outer primaries; tail, seen from below, greenish, not blackish.

ADULT FEMALE.—Quite different from the female of *chlorura* by having the crown grayish olive not brownish; wing with very little brown. For detailed description and measurements see: Amer. Mus. Novit., No. 531 (1932), pp. 3–6, under the name "*chlorura*."

RANGE.—Efate and Nguna Islands, New Hebrides.

Lack of material prevented me in 1932 from working out the characters of the Efate bird, although I stated (*loc. cit.*): "Judging from other cases, it is rather probable that the Erromanga and Efate birds are not the same." The splendid series gathered by Mr. L. Macmillan shows by what characters the already well-described, though unnamed, Efate form differs from *chlorura*. A more detailed description of *Pachycephala pectoralis chlorura* shall be given after the receipt of more material of *cucullata*.

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[1] For a description of *juliae* and the forms of the northern New Hebrides see Amer. Mus. Novit., No. 469 (1931), pp. 1–10.

Petroica multicolor cognata, new subspecies

TYPE.—No. 447436, Amer. Mus. Nat. Hist.; ♂ ad.; Erromanga Is., southern New Hebrides; March 5, 1937; L. Macmillan.

Similar to *P. m. soror*, but crissum and under tail-coverts clearer white; less scarlet on upper throat; scarlet of under parts more crimson, less mixed with orange; upper parts very much more grayish; with the red wash rather inconspicuous; outermost tail-feather completely white or at least with a great deal of white even on the inner web, while in *soror* the white on the outermost tail-feather is more or less restricted to a part of the outer web. *P. m. feminina* is very much more brownish and has also much less white on the tail.

Wing: 8 ♂ ad., 63–65 (63.8); 5 ♀ ad., 61–64 (62.5). Tail: 8 ♂, 42–46 (43.9); 5 ♀, 41–45 (43.2).

RANGE.—Erromanga Island, New Hebrides.

Only one immature male (Brit. Mus.) from Erromanga was available when I wrote my revision of this species (1934, Amer. Mus. Novit., No. 714) and I referred the Erromanga population temporarily to *similis*. The splendid series collected by Macmillan shows that it belongs to a different group of the species, namely, to the forms with the male in a retarded plumage. The next relatives of *cognata* are *feminina* in the Efate group and *soror* from Vanua Lava, Banks group.

Zosterops flavifrons efatensis Mayr

Erromanga birds average slightly larger and tend to have the upper parts darker and less yellowish, which is particularly conspicuous on crown and ear-coverts; the yellow of the forehead is usually more clearly defined and the under parts are slightly more orange-yellow. They tend in their coloration toward typical *flavifrons* from Tanna.

I feel that all these differences are too slight and too much obscured by individual variation to be used for establishing a new form.

Wing: 2 ♂ ad., 62, 66; 4 ♂ imm., 60, 60, 61, 61; 4 ♀ ad., 60–63. Tail: 2 ♂ ad., 45, 46; 3 ♂ imm., 43, 43, 45; 5 ♀ ad., 41.5–44.

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FOUR NEW MAMMALS FROM COSTA RICA

BY GEORGE G. GOODWIN

In a preliminary study of the Costa Rica mammals recently collected by the veteran collector, Mr. C. F. Underwood, and now in various museums of the United States, I find four new geographical races. Several new forms and one new genus have already been described from Underwood's Costa Rica material.

I am indebted to the Biological Survey and the Field Museum for permission to describe new species in their collections. It gives me pleasure to thank Major E. A. Goldman of the Biological Survey and Dr. Glover M. Allen of the Museum of Comparative Zoölogy for comparing the new forms with types in their collections and for the benefit of their valued opinions.

Potos flavus arborensis, new subspecies

Costa Rica Kinkajou

TYPE.—No. 250320, U. S. Nat. Mus. (Biol. Survey Coll.); female adult; El Sauce Peralta, a farm on the Atlantic railroad less than halfway from San José to Limon, Costa Rica; altitude about 1000 feet; June 4, 1931; collector, C. F. Underwood. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A large light-colored kinkajou, with dark dorsal line and dusky feet, large skull with flat bullae, and upper molars relatively narrow antero-posteriorly; larger and paler than *P. f. chiriquensis* from Boqueron, and also differs in distinctive cranial characters.

DESCRIPTION.—Color of upper parts in general about clay-color (color nomenclature that of Ridgway), hair dusky brownish for the greater part of its length, evenly covered with creamy buff, finely mixed with black-tipped hairs, purest on flanks and outer side of limbs; top of head and face darker than rest of body; a narrow blackish-brown dorsal stripe from crown of head to base of tail; under parts, including inner side of hind limbs and under side of basal half of tail, rich pinkish buff; ears thinly clothed with cinnamon-brown; feet and toes mummy brown; tail above about like back, but becoming darker toward tip.

SKULL.—Large, with high braincase; frontal profile convex; basioccipital broad; bullae flat and elongated; postorbital processes short and peg-like; palate short.

MEASUREMENTS.—Head and body, 476 millimeters; tail vertebrae, 496; hind foot (without claws), 98; ear, 38. Skull: greatest length, 93.5, condylobasal length, 87.8; zygomatic breadth, 62.3; interorbital breadth, 21.8; postorbital constriction, 22.1; breadth across mastoid processes, 37.3; breadth of braincase, 40.9 upper toothrow, from canine to back of last molar, 26.4.

Potos f. arborensis requires comparison only with *P. f. campechensis* and *P. f. chiriquensis*. Compared with *campechensis*, it is larger. The color is similar, but less yellowish, with more black on the feet; the braincase is much larger, higher, and more inflated; frontal profile more convex; postorbital processes shorter, more peg-like; basioccipital broader; palate shorter, more as in *chiriquensis;* bullae flatter, narrower, and more elongated antero-posteriorly; dentition similar but rather heavy. Compared with *chiriquensis*, *arborensis* is larger, much lighter in color, with larger skull, higher braincase, frontal profile more convex, postorbital processes similarly short and peg-like; palate short, as in *chiriquensis*, bullae more elongated posteriorly; dentition similar, but carnassials relatively broader than usual in *chiriquensis*. The narrow blackish median dorsal stripe may have no special significance, as this feature is variable in other forms.

Urocyon cinereoargenteus costaricensis, new subspecies

Costa Rica Gray Fox

TYPE.—No. 35170, Field Mus. of Nat. Hist.; male adult with worn molars; Savanilla de Pirris, a town on the Pacific coast range near Rio Grande de Pirris, Department of San José, Costa Rica; altitude about 500 feet; April 2, 1931; collector, C. F. Underwood. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A rather small dark-colored gray fox, with dark underfur and small skull with short slender rostrum, small rounded bullae, small teeth and relatively long palate.

DESCRIPTION.—Pelage moderately long and coarse; upper parts gray formed by the nearly equal mixture of black tips and white subterminal bands of the coarse hairs; underfur on back Prout's brown completely covered by overlying guard hairs; top of head like back, but more finely grizzled; black tips of sides less conspicuous than on back and underfur pinkish buff; outside and behind base of ear between dull ochraceous tawny and hazel; tip of ear mixed with black hairs, inner side of ear whitish; chin, under side of mouth and muzzle mummy brown finely mixed with white; lips and from corner of mouth to throat dull white; upper side of fore and hind limbs and feet a mixture of black and buff; inner and under side of limbs cinnamon-buff; tail, above, mixed buff and black, tip black, under side of tail cinnamon-buff; under parts, hair broadly drab from base and tipped with cinnamon-buff; indefinitely along median line and between hind limbs, pectoral area and throat buffy white.

SKULL.—Small, with short, slender rostrum, and small rounded bullae; teeth small, the longitudinal axis of the third upper premolar not in a plane parallel to that of first and second, but anterior edge turned in so that there is a relatively sharp angle in the toothrow at this point; palate long, interpterygoid fossa not extending forward beyond a plane between the posterior edge of last molars; mandible short, teeth crowded; ascending ramus very broad and upper edge sloping evenly backward to coronoid process.

MEASUREMENTS.—Skull: greatest length, 111.2; basal length, 103.6; palatal length, 55.5; zygomatic breadth, 61.4; least interorbital breadth, 21; length of audital bullae, 16.6; upper toothrow, exclusive of incisors, 45.7; lower toothrow, exclusive of incisors, 51.3; combined length of upper molars, 13.

Compared with specimens of *U. guatemalae* from Guatemala the Costa Rica gray fox is generally darker in color throughout, without the bright, tawny shades about the ears and white on under side of limbs and body; skull smaller, bullae smaller and more rounded, teeth smaller, and a sharper angle in the maxillary toothrow at pm^3; mandible shorter and heavier, with wider ascending ramus. Compared with *U. c. furvus*, from Panama, the Costa Rica gray fox is a much darker and less buffy animal, with more abundant black-tipped hairs; underfur everywhere very much darker; head less buffy and the limbs and feet darker. The skull of *costaricensis* is noticeably larger and broader than that of *furvus*, rostrum heavier, interpterygoid fossa broader and shorter, space between the bullae wider and teeth differently spaced. In spite of the shorter skull in *furvus*, the individual teeth are not significantly larger, although m^2 is visibly larger than in *costaricensis*, and pm^3 overlaps the inner cone of pm^4.

Besides the type there are skulls of an adult female and a young male from Pozo Azul, Costa Rica, in the American Museum collections.

Peromyscus nudipes orientalis, new subspecies

Eastern Costa Rica White-footed Mouse

TYPE.- No. 123494, Amer. Mus. Nat. Hist.; male adult; El Sauce Peralta, Costa Rica, a farm on the Atlantic railroad, less than halfway from San José to Limon; altitude about 1000 feet; July 7, 1931; collector, C. F. Underwood. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A medium-sized mouse with rather full and soft pelage; moderate-sized ears, nearly naked; relatively short tail, nearly unicolor, scaly with very short stiff hairs; soles of hind feet narrowly naked medianly; skull similar to *nudipes* but smaller.

DESCRIPTION.—Unworn pelage, upper parts between ochraceous tawny and clay-color mixed with black, forming a broad blackish-brown area from crown of head to base of tail; sides of body and cheeks chiefly clay-color; ring around eye blackish; ears dusky; fore feet white, forearm dusky nearly to wrist; hind feet white with a wedge of dark color extending to just below tarsal joint; tail yellowish white, above, slightly paler below, becoming black all around at tip; under parts white washed with cinnamon-buff; pectoral spot of clay-color.

SKULL.—Relatively small, broad, with wide braincase and spreading zygomatic arches; molar teeth small; nasals short, terminating in front of the fronto-premaxillary sutures, similar to *P. nudipes* but much smaller with smaller teeth.

MEASUREMENTS OF TYPE.—Head and body, 116 millimeters; tail vertebrae 124; hind foot, 27; ear, 21. Skull: greatest length, 33; zygomatic breadth, 15.7;

interorbital constriction, 5.2; length of nasals, 12.5; alveolar length of upper molar series, 4.8. Adult male topotype, 115, 130, 26, 33, 16, 4.8, 13, 4.5.

Externally *P. nudipes orientalis* may be distinguished from typical *P. nudipes* by its smaller size, shorter tail, shorter and somewhat coarser pelage which is a dull clay-color instead of the ochraceous-russet shades in *P. nudipes*.

El Sauce Peralta is in the lowlands near the Atlantic coast and seems the best place for the type locality. Specimens from Cervantes, while showing a somewhat greater development in the characters of this new form, come very near the type locality of typical *P. nudipes*. The series from Cervantes have under parts stained with clay-color. This may be due to the preservative in the preparation of the specimens or to the juice of some kind of fruit or vegetable matter.

Liomys salvini aterrimus, new subspecies

Western Costa Rica Spiny Pocket Mouse

TYPE.—No. 35211, Field Mus. Nat. Hist.; female adult; Savanilla de Pirris, a town on the Pacific coast range, near the Rio Grande de Pirris, Department of San José, Costa Rica; altitude probably about 500 feet; April 12, 1931; collector, C. F. Underwood. Only one specimen known—the type. Skin and skull in good condition.

GENERAL CHARACTERS.—A small dark-colored pocket mouse, without yellowish lateral line; a narrow slaty gray edging on outer side of forearm; sole of hind foot hairy posteriorly and six-tuberculate; similar in general color and size to *L. s. nigrescens*, but differing in longer tail, blacker pelage, and distinctive cranial characters.

DESCRIPTION.—Pelage moderately long and hispid; tail very long in comparison with hind foot; color of upper parts from tip of nose to base of tail uniform brownish black; ears dusky, sparsely covered with fine black hairs; tail distinctly bicolored, blackish brown above, white below except tip, which is blackish all around; forearms white, with a few scattered dusky hairs on outer side; forefeet white; outer side of hind limbs like back, the dark color extending down upper side of hind limbs to halfway between toes and ankles; soles of feet posteriorly and under sides of ankles dusky; under parts, including lips, chin, inner side of hind limbs and upper sides of hind feet and toes creamy white.

SKULL.—Similar in size to *L. s. nigrescens*, but not depressed in parietal region; premaxillae broad reaching posteriorly well beyond nasals; nasals long and narrow, tapering evenly; rostrum long and broad; superorbital ridges weakly developed; upper incisors large.

MEASUREMENTS.—Head and body, 110 millimeters; tail vertebrae, 132; hind foot (without claws), 25; ear, 14. Skull: greatest length, 34.2; zygomatic breadth, 16; interorbital breadth, 7.5; length of nasals, 13.8; breadth of rostrum, 6.15; alveolar length of upper molar series, 4.9.

The Savanilla specimen shows characters which, if constant, differentiate the form probably inhabiting the general lowland region of western

Costa Rica. The tail in this specimen is very long in comparison with the hind foot and, while it is a rather old adult, the broad rostrum, broad premaxillae, and very large upper incisors, as compared with specimens of *L. s. nigrescens*, from 4000 feet elevation at Villa Colon, seem to be beyond the range of individual variation.

Major Goldman is of the opinion that specimens from near San José probably represent typical *nigrescens* and that, from what we know of the range of this group on geographical grounds, we could expect the occurrence of a different form near the west coast. The type locality for *L. s. nigrescens* has not been fixed. According to Goldman, it seems a fairly reasonable assumption that it must have come from a more accessible part of Costa Rica, which would probably have been either the east side or the highlands which were generally worked many years ago.

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UPPER MIOCENE MOLLUSCA FROM SPRINGVALE, TRINIDAD, BRITISH WEST INDIES

BY H. E. VOKES

The importance of the upper Miocene fauna occurring at Springvale, Trinidad, British West Indies, has been recognized since the locality was first reported in 1910 but, although it has received attention in reports dealing with the general problem of the Miocene faunas of the Island, it has not been the subject of any detailed study.

A collection of fossils from the Tertiary deposits of Trinidad recently received by the Department of Geology and Invertebrate Palaeontology of The American Museum of Natural History from Mr. Carlos H. Jooss of Georgetown, British Guiana, contains a representative suite of mollusca from this locality which has furnished the basis for the present study.

The Springvale fauna is known from a quarry in west central Trinidad, which is "situated on the side of a low hill, one of the lateral spurs of the Montserrat range" (Guppy, 1911, p. 195) in "Caroni County, Couva Ward, at Springvale, on Mount Pleasant Road and three-fourths to one mile south of Milton" (Mansfield, 1925, p. 7). Maury (1925, p. 162) has reported deposits of Springvale age from other localities on the Island but in the type region it is definitely known only from the one quarry. The strata are covered by recent deposits and their extent is not certainly known.

The discovery of the Springvale locality was reported in 1910 by R. J. Lechmere Guppy in a paper 'On a collection of fossils from Springvale, near Couva, Trinidad' presented before the Agriculture Society of Trinidad and Tobago, and published as Society paper No. 440. Appended was a 'List of the Miocene Molluska of Trinidad, 1910' in which 31 species of mollusca, 1 barnacle and 1 echinoderm were indicated as occurring here. In the following year a report, 'Fossils from Springvale near Couva, Trinidad—Second Report—In Continuation on Society Paper No. 440,' published as Society paper No. 454, added 22 species of mollusca to the list including 5 new forms, described as: *Natica cuspidata*, *Capulus effluens*, *Solenosteira semiglobosa*, *Solenosteira co-*

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chlearis and *Raëta meridionalis.* A sixth species, listed as "*Placenta patinata* new species near *orbicularlis*" and without any indication as to the location from which it was obtained, is a *nomen nudum,* lacking both description and figure.

In these reports Guppy indicated that the Springvale deposits were of Miocene age, considering them as approximately equivalent to the Bowden Beds of Jamaica.

In 1925, Dr. C. J. Maury in a report entitled 'A Further Contribution to the Palaeontology of Trinidad (Miocene Horizons)' described 32 species of pelecypods and 47 gastropods from this locality. Thirty-eight of the species are new. The fauna is referred to the lower part of the upper Miocene (p. 168).

Later, during the same year, Dr. W. C. Mansfield contributed 'Miocene Gastropods and Scaphopods from Trinidad, British West Indies.' He lists 24 species of gastropoda and 1 pelecypoda from Springvale, describing 7 new species of gastropoda. The fauna is "tentatively referred to the upper Miocene."

COMPOSITION OF THE MOLLUSCAN FAUNA

The reports of Maury and Mansfield with some modifications based upon the present collection, together with the fossils in The American Museum of Natural History, permit the following faunal list from the Springvale locality[1]:

PELECYPODA	Maury	Mansfield	Amer. Mus. Coll.
Nuculana species			X
Arca (*Arca*) *occidentalis miocica*, n. subsp.	X		*
Anadara (*Anadara*) *confugium* (Maury)	*		
Anadara (*Anadara*) *couvae* (Maury)	*		
Anadara (*Anadara*) *fontinalis* (Maury)	*		X
Anadara (*Anadara*) *springvalensis*, n. sp.			*
Anadara (*Anadara*) *tectum-columbae* (Maury)	*		X
Anadara (*Anadara*) *thauma* (Maury)	*		X
Barbatia (*Cucullaria*) *perinopinata* Maury	*		X
Noetia centrota Guppy	X		
Ostrea (*Lopha*) *haitensis* Sowerby	X		X
Ostrea (*Lopha*) *messor* Maury	*		X
Pecten (*Pectren*) *archon* Maury	*		X

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[1] Those species marked with an asterisk were described from this locality in the report indicated; those marked with the symbol "X" are reported as present here.

	MAURY	MANSFIELD	AMER. MUS. COLL.
Chlamys (*Plagioctenium*) *demiurgus* (Dall)	X		X
Chlamys (*Plagioctenium*) *reedsi*, n. sp.			*
Amusium (*Amusium*) *rex-maris* Maury	*		X
Anomia simplex d'Orbigny			X
Volsella (*Volsella*) *waringi* (Maury)	*		X
Crenella divaricata d'Orbigny	X		X
Eucrassatella trinitarius (Maury)	*		X
Eucrassatella montserratensis (Maury)	*		X
Crassinella guppyi Dall	X		X
Venericardia (*Pleuromeris*) cf. *acaris* Dall			X
Trachycardium caroniense Maury	*		
Trachycardium couvense Maury	*		
Laevicardium serratum (Linnaeus)	X		
Dosinia (*Dosinidia*) *titan* Maury	*		X
Clementia dariena Conrad			X
Macrocallista (*Paradione*) *maculata* (Linnaeus)	X		X
Pitar species			X
Antigona (*Dosina*) *mauryae*, n. sp.			*
Chione (*Chione*) *pubera* (Valenciennes)	X		
Chione (*Chione*) *springvalensis*, n. sp.			*
Chione (*Lirophora*) *caroniana* Maury	*		X
Tellina (*Tellinella*) *caroniana* Maury	*		X
Tellina couvaënsis, n. sp.			*
Metis trinitaria Dall	X		X
Semele claytoni couvensis Maury	*		
Semele anteriocosta, n. sp.			*
Pleiorytis caroniana (Maury)	*		X
Psamosolen (?) *mansfieldi*, n. sp.			*
Raëta meridionalis Guppy	X		X
Pholadomya, n. sp.			X
Corbula (*Corbula*) *isla-trinitatis* (Maury)	X		X
Corbula (*Caryocorbula*) species			X
Gastrochaena couvana, n. sp.			*
Kuphus incrassatus Gabb	X		X
GASTROPODA			
Terebra (*Paraterebra*) *sulcifera* Sowerby	X		
Terebra (*Paraterebra*) *bipartita* Sowerby	X		
Crassispira henekeni caroniana (Maury)	*		X
Knefastia (?) *springvaleënsis* (Mansfield)		*	
"*Drillia*" aff. *D. rioguraboni*s Maury		X	
Conus (*Leptoconus*) *medialira*, n. sp.			X
Conus (*Leptoconus*) *springvaleënsis* Mansfield		*	*

	MAURY	MANSFIELD	AMER. MUS COLL.
Conus (*Lithoconus*) *couvaënsis*, n. sp.			*
Conus (*Dendroconus*) *maga*, n. sp.	X		*
Conus species (*C. planiliratus* Sow. of Maury)	X		
Cancellaria (*Cancellaria*) *auriculaperta*, n. sp.			*
Cancellaria (*Cancellaria*) *couvana*, n. sp.			*
Cancellaria (*Cancellaria*) *montserratensis* Maury	*		X
Cancellaria (*Cancellaria*) *springvaleënsis* Mansfield		*	
Oliva (*Oliva*) *cylindrica* Sowerby	X	X	X
Oliva (*Oliva*) *couvana* Maury	*		X
Olivella (*Dactylidia*) *mutica* Say	X		
Ancilla (*Eburna*) *caroniana* Maury	*	X	X
Ancilla (*Eburna*) *caroniana springvaleënsis* Mansfield		*	X
Marginella (*Egouana*) *calypsonis* Maury	*	X	X
Marginella (*Leptegouana*) *springvalensis* Maury	*	X	X
Marginella (*Volutella*) *maiae* Maury	*		
Marginella (*Persicula*) *couviana* Maury	*		
Marginella (*Persicula*) *propeobesa* Mansfield		*	
Marginella (*Closia*) *lachrimula* Gould ?		X	
Mitra (*Tiara*) *couvensis* Maury	*	X	X
Mitra (*Tiara*) *sancti-francisci* Maury	*		
Mitra (*Tiara*) *woodringi*, n. sp.			*
Xancus trinitatis Maury	*		X
Xancus praeovoideus Maury	X		
Latirus (*Polygona*) *infundibulum polius* Woodring			X
Fasciolaria, sp. indet.	X		
Fusinus springvalensis (Maury)	*		X
Melongena consors Sowerby	X		
Tritiaria (*Antillophos*), n. sp.			X
Solenosteira semiglobosa Guppy	X	X	X
Solenosteira semiglobosa cochlearis Guppy	X		X
Murex (*Murex*) *recurvirostris* Broderip			X
Murex (*Phyllonotus*) *cornurectus* Guppy	X		
Cassis species aff. *tuberosa* Lamarck			X
Semicassis (*Tylocassis*) *maleaformis*, n. sp.			*
Ficus carbasea (Guppy)	X		X
Cypraea caroniensis Maury	*		X
Bittium species		X	
Vermicularia spirata (Philippi)	X		X
Vermicularia cf. *eburneus* Reeve		X	
Lementina papulosa (Guppy)	X		X
Lementina decussata (Gmelin)	X		
Petaloconchus alcimus Mansfield	X	*	X
Turritella planigyrata Guppy	X	X	X

Turritella trinitaria Maury	*		X
Turritella guppyi Cossmann (*tornata* Guppy, not Klipstein)	X		
Architectonica (*Architectonica*) *nobilis* ((Bolten) Roëding)	X		X
Rissoa species			X
Capulus efluens Guppy[1]			
Capulus (*Malluvium*) species			X
Calyptraea centralis (Conrad)			X
"*Calyptraea*," n. sp.			X
Crepidula fornicata Linnaeus	X		X
Natica youngi Maury	*	X	X
Natica (*Naticarius*) *canrena* Morch	X	X	X
Natica cuspidata Guppy	X	X	X
Polinices stanislas-meunieri Maury	X		X
Polinices springvalensis Maury	*		X
Polinices cf. *subclausa lavelana* Hodson			X
Sinum naticoidalis, n. sp.			*
Epitonium (?) *leroyi* (Guppy)	X		X
Turbonilla species		X	
Eulima egregia Guppy	X		X
Calliostoma (*Calliostoma*) *caroniana* Maury	*		
Solariella caroniana Maury	*		X
Teinostoma (*Pseudorotella* ?) *caroniense* Maury	*		X
Fissuridea species		X	

A summary of the preceding list shows:

	PELECYPODA			GASTROPODA			TOTAL		
	New	Previously Described	Total	New	Previously Described	Total	New	Previously Described	Total
Maury	19	13	32	19	26	45	38	39	77
Mansfield		1	1	7	17	24	7	18	25
Amer. Mus. Coll.	9	30	39	8	41	49	17	71	88
Fauna	28	19	47	34	38	72	63	57	120

Of these, three pelecypods and six gastropods have not received specific names, leaving a total of 111 named species. Woodring (1928, p. 22), lists a fauna of 610 species from the Middle Miocene at Bowden, Jamaica, and estimates that a tropical molluscan fauna including every ecologic nitch from shore to a depth of 100 fathoms, plus the pelagic forms, would include about 1000 species. No one fossil locality can be expected to yield a complete fauna. Nevertheless, these figures do serve to emphasize that our knowledge of the Springvale mollusca is still incomplete. Further collecting should record many additional species from this locality.

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[1] Described from Springvale, but not subsequently reported.

NOTES ON THE ECOLOGY OF THE SPRINGVALE FAUNA

The present incomplete knowledge of this fauna as well as the paucity of the data on the ecology of the recent marine molluscan faunas does not permit an adequate analysis of the ecologic factors which obtained during the period of the deposition at Springvale. However, enough can be adduced to permit some suggestions pertinent to the problem at hand.

Salinity.—None of the species at present reported tend to suggest the presence of waters of less than the normal salinity of the open sea. Further, the absence of species referable to *Neritina*, *Corbicula*, the Cerithiidae, and other generic groups which are more commonly found in waters of less than normal salinity, indicates that no fresh or brackish waters emptied into the sea in the immediate vicinity.

Character of the Bottom.—The matrix, observable on the fossils, is a fine to medium sand with an abundant admixture of clay. No pebbles have been noted. Insofar as records based mainly on shore collecting are available, the majority of the genera represented in the fauna are those which are to be expected on this type of deposit. Genera represented in the fauna which either prefer or often may be found on, or in, sand or sandy mud, include[1]:

Pecten
Venericardia
Macrocallista
Tellina
Corbula
Crassispira
Olivella
Mitra
Turritella
Polinices
Eucrassatella
Trachycardium
Antigona
Metis
Kuphus
Cancellaria
Ancilla
Murex
Architectonica
Sinum
Dosinia
Laevicardium
Chione
Semele
Terebra
Oliva
Marginella
Ficus
Natica

Woodring (1928, p. 31) lists *Conus*, *Mitra* and *Murex* among the genera that lurk beneath or among stones, and *Arca* among those which nest between the stones. Records in Carpenter (*op. cit.*) seem to indicate that *Conus* retreats under stones when exposed by the ebb tide, but when not thus exposed it may occur "on sands in small ponds of sea water" and on "sandy mud" (pp. 181, 205, 270). The same seems to hold true for *Mitra* and *Murex*. Specimens of *Murex recurvirostris*

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[1] In this connection attention is directed to the 'Report on the Present State of Our Knowledge with regard to the Mollusca of the West Coast of North America,' by Dr. P. P. Carpenter, in the Report of the British Association for the Advancement of Science for 1856 (1857), pp. 159–368. This is in part a compilation of all published reports up to that time listing mollusca from that region, together with any reliable data as to the habitat and depth from which the specimens were collected.

Broderip are stated to have been taken by Cuming from sandy mud at 9 fathoms (p. 182). These genera are active predators and undoubtedly range widely along the bottom below the areas exposed by the tide.

All of the specimens of *Arca* (*Arca*) *occidentalis miocica* are of individual valves and may have been transported before burial. All, save one, are too well preserved to lend much support to this possibility; the exception is somewhat broken and well covered by bryozoa. It is possible that the large shells of *Ostrea* (*Lopha*) *haitensis* Sowerby furnished suitable places for "nesting" and byssal attachment. The majority of the specimens of *Anadara* have both valves in association, arguing against subsequent transportation. Not rarely, species of this genus appear to be taken from sand and sandy mud below low tide level. (Carpenter, 1857, pp. 183, 277–8.)

Gastrochaena is the only boring pelecypod recognized. The species of this genus bore into shells as well as coral and soft rock. The specimens of *Ostrea haitensis* show bore holes, although none are of sufficient size to accommodate the single large specimen in the collection. The valves of this individual are in association, one crushed within the other, suggesting again an absence of transportation before burial.

Cypraea and *Xancus* appear to be wholly partial to stony environments and no records of their occurrence on sandy or muddy bottoms have been noted. While neither genus is common in the collection they are not rare and the shells are not worn. They furnish an unexplained element in the fauna. *Latirus* is most commonly found among or under stones and is well represented in the fauna. The great majority of the specimens are covered with bryozoa and do not preclude the possibility of their being an introduced element.

If, as seems most probable, the bottom was a sandy mud, the entire absence of species of *Glycymeris* and of the *Lucinidae*, together with a relative rarity of *Cardiidae* in all reported collections from Springvale is not easily explained. All are normally abundant in the Miocene faunas of the West Indian and Caribbean region and all prefer the type of substratum which seems to have been present here. It must be assumed that some ecologic factor as yet not evident for this fauna is responsible for this condition.

DEPTH.—All factors seem to indicate relatively shallow waters during the period of deposition. No deep sea forms have been reported. *Raëta* (*R. meridionalis*) which normally lives in waters of less than 50 fathoms, is a significant element in the fauna. All the specimens which have been observed or reported have both valves in association and the same holds true for the majority of specimens of *Dosinia* (*Dosinidia*) *titan* Maury and the species of *Eucrassatella*.

Arca (Arca) occidentalis Phillipi **miocica,** new subspecies

Figure 1

Arca occidentalis Phillipi, Maury, 1925, p. 186 (Springvale record only).

Holotype.—No. 24983[1]; length 67.8 mm.; height 30.0 mm.; diameter (one valve) 16.5 mm.

The fossils from Springvale differ from the recent *Arca occidentalis* in the possession of a deeper flexure extending from the umbo to the posterior emargination resulting in a more sharply delimited posterior dorsal area. The ribbing on the shell between the median umbonal depression and the posterior keel immediately ventral to the posterior emargination tends to be much finer, the interspaces being twice the width of the rib. Each interspace is generally marked by a median secondary riblet with three to five fine, microscopic tertiaries on each side.

This subspecies appears to be a geographic variant of the typical *A. occidentalis* stock which is present in the middle Miocene at Bowden and on the Island of Santo Domingo. Specimens in the collections of the American Museum from the Pliocene of Trinidad are to be referred to *A. o. occidentalis* rather than to this subspecies.

Anadara (Anadara) thauma (Maury)

Scapharca (*Scapharca*) *thauma* Maury, 1925, p. 214.

Arca (*Scapharca*) *thauma* Maury, 1925, Pl. xii, fig. 3.

The tendency toward the development of medial grooves on the radial ribs of this species is to be noted over the entire surface of the valve rather than only on the anterior and posterior regions, though the grooving may be obsolete over the median portion of the surface. The posterior ribs are commonly as strongly grooved as those on the anterior area of the shell.

A. thauma resembles *A. hallidonta oresta* (Woodring) (1925, p. 43, Pl. iv, figs. 5, 6) but differs in being proportionally more elongate and in possessing a greater number of radial ribs, there being 34 in the Bowden species and 38 to 40 in *A. thauma*.

The original figures of *A.* (*Anadara*) *tectum-columbae* (Maury) (1925, p. 204, Pl. xviii, fig. 4), and of *A.* (*Anadara*) *fontinalis* (Maury)

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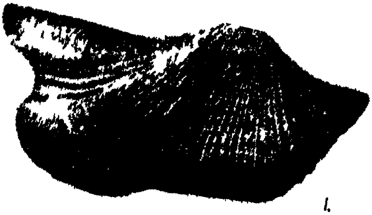
[1] All specimens described and figured are in the collections of the Department of Palaeontology at The American Museum of Natural History.



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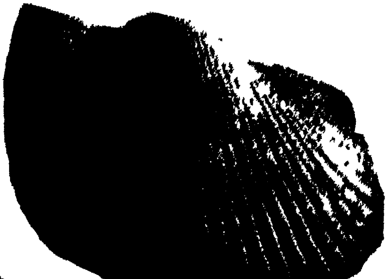

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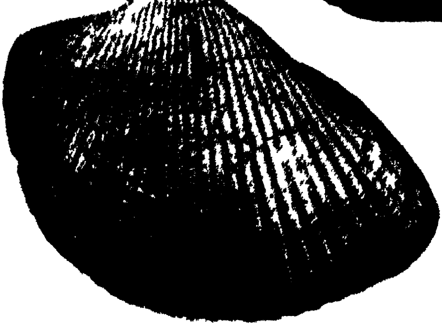

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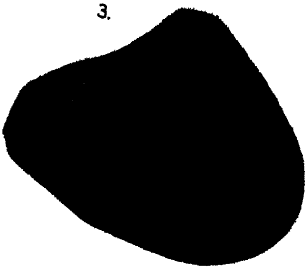

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Fig. 1. *Arca (Arca) occidentalis miocica*, n. subsp. Holotype, No 24983; ×1.
Fig. 2. *Anadara (Anadara) fontinalis* (Maury). Topotype, No 24984; ×1
Fig. 3. *Anadara (Anadara) springvalensis*, n. sp. Holotype, No. 24985; ×1.
Fig. 4. *Eucrassatella montserratensis* (Maury). Topotype, No. 24473; ×1.

(1925, p. 207, Pl. xvii, figs. 7, 8) are defective. The former has been well figured by Harris (in Waring, 1926, Pl. xx, figs. 1, 2) as "*Arca tectum-columbae* var." The holotype of this species appears from the original figures to be much crushed and topotype material in our collections suggests that Harris' variety is the typical form not distorted.

A. fontinalis is here figured (Fig. 2; topotype No. 24984; length 73.5 mm.; height 43.6 mm.; diameter, both valves, 35.0 mm.).

Anadara (Anadara) springvalensis, new species

Figure 3

HOLOTYPE.—No. 24985; length 83.8 mm.; height 52.5 mm.; diameter (one valve) 25.5 mm.; length of cardinal area 62.6 mm.

DESCRIPTION.—Shell large, elongate, subtrapezoidal, strongly inflated; umbos relatively small, situated at the anterior third of the valve; anterior lateral and ventral margins broadly and regularly rounded, rounding sharply at the posterior end to the obliquely truncated, straight posterior lateral margin; surface of the valve ornamented with 36 radial ribs separated by rounded interspaces of approximately equal width; the twelve anterior ribs bear a prominent medial groove, those on the medial portion of the valve tend to be flat-topped and to increase in height and width posteriorly becoming more than one and one-half times the width of the anterior ribs on this portion of the surface of the valve; the ribs extending to the posterior lateral margin are broad and low, becoming obsolete dorsally with interspaces narrower than the ribs; hinge typical but relatively short as compared with the length of the valve.

A. springvalensis differs from *A. thauma* Maury in possessing fewer radial ribs. In the latter species these are wider than the interspaces. The most striking difference, however, is in the shape of the valves, which in the new species are more broadly rounded anteroventrally and ventrally, more sharply rounded to sub-angulate posteriorly and more sharply oblique on the posterior lateral margin. In general appearance it is reminiscent of *A. seticostata* (Reeve) but is more sharply produced posteriorly and differs in the details of the ornamentation.

Chlamys (Plagioctenium) reedsi, new species

Figure 7

HOLOTYPE.—No. 24989; height 75.6 mm.; length 74.0 mm.; diameter (one valve) 16.5 mm.

DESCRIPTION.—Shell moderately large, nearly equilateral, of approximately equal height and length; right valve with umbo high, moderately inflated, slender; surface ornamented with 20 strong, almost flat-topped ribs separated by interspaces of slightly narrower width; ribs and interspaces marked by fine, sub-microscopic radial striae visible only toward the periphery of the valve; concentric sculpture consisting of fine, raised lamellae which are visible only on the sides of the ribs on the upper part of the shell; submargins marked by three fine radial threads delimiting them from the disk, with concentric sculpture finer than on the disk; ears subequal, anterior with four primary and four secondary radial ribs; posterior smooth dorsally and with eight radial ribs ventrally.

Chlamys (*Plagioctenium*) *demiurgus* (Dall) (1898, III, pt. 4, p. 718, Pl. XXVI, fig. 3) with which *C. reedsi* is associated at Springvale tends to be longer than high, has a shorter anterior margin, lacks the fine radial striae on the ribs and interspaces and differs in the details of the ornamentation of the auricles. The fine concentric lamellae on *C. reedsi* probably over-rode the radial ribs as in *C. demiurgus*, but have been eroded away.

This species is named in honor of Dr. Chester A. Reeds, former Curator of the Department of Geology and Invertebrate Palaeontology of The American Museum of Natural History, who arranged for the acquisition of the collection here described.

Amusium rex-maris Maury

Amusium rex-maris MAURY, 1925, p. 242, Pl. XXVI, fig. 1.

The holotype of this species has only the interior of the valve exposed. A topotype in our collection shows that this species lacks umbonal sculpturing on the exterior of the valve.

Anomia simplex d'Orbigny

Anomia simplex D'ORBIGNY, 1845, in de la Sagra, 'Hist. Fiscia, Pol. y Nat. Isla de Cuba,' V, *Moluscos*, p. 371, Atlas, p. 75, Pl. XLIII, fig. 4.

Anomia ephippium CONRAD, 1845, 'Medial Tert. Fossils,' p. 75, Pl. XLIII, fig. 4. Not *A. ephippium* LINNAEUS, 1758, 'Syst. Nat.,' Ed. 10, p. 701.

The specimens referred to this species are somewhat larger than the normal recent form and tend to be marked by an extra thickening of the shell along the dorsal margin. They are normal in all other characteristics.

Eucrassatella montserratensis (Maury)

Figure 4

Crassatellites (*Scambula*) *montserratensis* MAURY, 1925, p. 328, Pl. XLII, fig. 3.

TOPOTYPE.—No. 24473; length 55.0 mm.; height 38.6 mm.; diameter (both valves) 20.0 mm.

The holotype is an imperfect example, incomplete ventrally and apparently somewhat distorted by pressure. The specimen here figured is almost perfect and permits the following additional notations concerning this species: The valves are equal and equally convex; the posterior end may be somewhat more produced than is indicated by the type, and the umbo is slightly anterior to the mid-line of the valve; the anterior dorsal margin is slightly convex, the anterior lateral margin broadly and regularly rounded, the ventral edge almost straight becoming slightly concave posteriorly at the sulcation in front of the umbonal carina. The posterior lateral margin is short and almost straight.

E. montserratensis may be distinguished from *E. trinitarius* (Maury) (1925, p. 327, Pl. XLII, figs. 1, 7; as *Crassatellites* (*Scambula*)) also described from Springvale, by the higher more inflated umbos, the coarser concentric umbonal waves, the smooth anterior region of the shell and the narrower posterior sulcation.

Venericardia (Pleuromeris) cf. acaris Dall

cf. *Venericardia* (*Pteromeris*) *acaris* DALL, 1903, III, pt. 6, p. 1434, Pl. LVI, fig. 4.

Three left valves agree in shape and in the number and character of the radial ribs with this species which was described from the Bowden Beds of Jamaica. However, the row of oblique rugae along the margin of the lunule has not been observed. (See Woodring, 1925, p. 102.)

Antigona (Dosina) mauryae, new species

Figure 10

HOLOTYPE.—No. 24463; length 84.0 mm.; height 70.0 mm.; diameter (both valves) 34.4 mm.

DESCRIPTION.—Shell large, elongate-ovate, inequilateral, moderately inflated; umbos small, low, strongly prosogyrate, situated within the anterior third of the shell; lunule moderately large, elongate, poorly delimited; escutcheon large, excavated, prominent, on left valve; absent on right; anterior lateral margin broadly and regularly rounded, ventral strongly convex; posterior dorsal margin strongly convex, posterior end sub-truncate, sharply round ventrally, slightly concave dorsally; a broad concave area extends from the umbos to the posterior lateral margin; surface ornamentation consisting of low, rounded, radiating ribs separated by interspaces of equal width; superimposed are prominent concentric lamellae, sub-equally spaced and crenulated by the radial ribbing; hinge and interior not seen.

This species is probably to be considered the Miocene precursor of the recent *A.* (*Dosina*) *listeri* (Gray). As figured by Palmer (1927–1929, Pl. XXVIII, figs. 2–11) that species is relatively less elongate with more prominent umbos and differs considerably in outline, particularly in the posterior portion of the valve. All other described species of this subgenus from this region appear to have larger and more inflated umbos and to be relatively less elongate.

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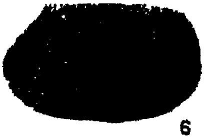

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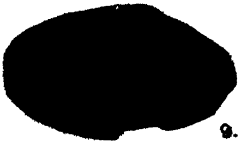

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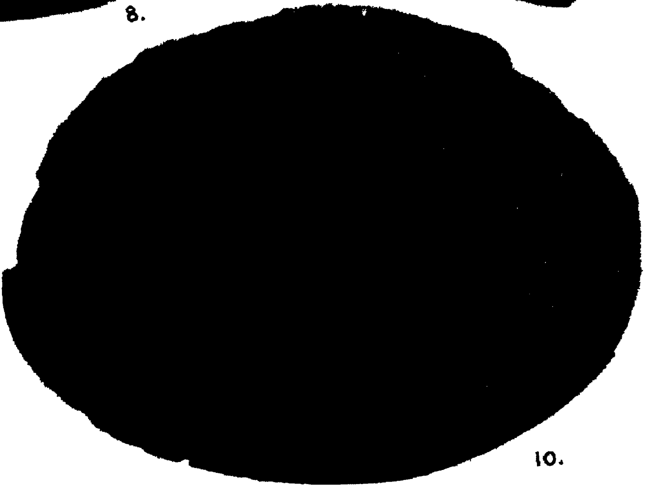

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Fig. 5 *Semele anteriocosta*, n. sp Holotype, No 24986; ×1

Fig. 6. *Chione* (*Chione*) *springvalensis*, n. sp. Holotype, No 24987; ×4.5

Fig. 7. *Chlamys* (*Plagioctenium*) *reedsi*, n sp. Holotype, No 24989; ×1

Fig 8. *Gastrochaena couvana*, n. sp. Holotype, No. 24990; ×2

Fig 9. *Tellina couvaensis*, n sp. Holotype, No. 24812; ×1.

Fig. 10. *Antigona* (*Dosina*) *mauryae*, n. sp. Holotype, No. 24463; ×1.

Chione (Chione) springvalensis, new species

Figure 6

HOLOTYPE.—No. 24987; length 5.5 mm.; height 4.0 mm.; diameter 1.6 mm.

DESCRIPTION.—Shell small, moderately inflated, elongate-ovate; umbos anterior, situated just behind the anterior one-fourth of the valve; surface ornamented with about 28 strong radial ribs which tend to be deeply grooved or bifurcate on the ventral half, radials crossed by concentric lamellae which became somewhat beaded on the ribs; lunule large, bounded by a shallow groove and marked by microscopic radial striations; escutcheon long, moderately broad, smooth, with a distinct groove paralleling the ligamental area; hinge typical.

This small species resembles the Bowden form *Chione* (*Chione*) *returgida* Woodring (1925, p. 161, Pl. XXII, figs. 5, 6) in size and general outline, but differs in the more anteriorly situated umbos and in the details of the sculpturing.

Tellina couvaënsis, new species

Figure 9

HOLOTYPE.—No. 24812; length 32.7 mm.; height 19.5 mm.; diameter (both valves) 8.6 mm.

DESCRIPTION.—Shell of medium size, thin, elongate-ovate, inequilateral, moderately inflated; anterior end, broad, produced, rounded; posterior short, slightly flexed, roundly pointed; umbos at posterior third of the valve; surface polished, marked only by weak, distant, concentric rugae; interior of shell not observed.

This species is represented only by the holotype and until the hinge and pallial sinus can be studied it is not possible to make a definite assignment to any section of the genus *Tellina*. It somewhat resembles the Bowden species *T.* (*Eurytellina*) *spiekeri* Woodring (1925, p. 168, Pl. XXIII, figs. 10, 11) but is larger than that form, rostrate and more sharply rounded posteriorly.

Semele anteriocosta, new species

Figure 5

HOLOTYPE.—No. 24986; length 26.3 mm.; height 18.8 mm.; diameter (both valves) 7.0 mm.

DESCRIPTION.—Shell relatively small, elongate-ovate; umbos low, slightly posterior; posterior dorsal margin slightly convex, anterior broadly convex, anterior and ventral margin broadly and regularly rounded, posterior almost straight; a marked umbonal groove parallels the posterior dorsal margin of the right valve with a complementary, but low, inconspicuous ridge on the left; surface marked by low, equidistant concentric lamellae which tend to be obsolete toward the posterior; the anterior end sculptured with numerous (11 to 17) fine radial ribs of varying width which tend to "frill" the concentric sculpturing; hinge typical, pallial sinus not seen.

This species may be distinguished by the fine radial ribs present on the anterior portion of the valve. It approaches *Semele quirosana*

H. K. Hodson (1931, p. 17, Pl. IX, figs. 8, 12) of the upper Oligocene of Venezuela in shape and size, but that species lacks the radial ribbing, has somewhat finer concentric sculpturing and the umbos are somewhat more anterior.

Pleiorytis caroniana (Maury)

Figure 11

Petricola caroniana MAURY, 1925, p. 274, Pl. XX, fig. 16.

Asaphis delicatus WEISBORD, 1929, Bull. Amer. Paleo., XIV, p. 257, Pl. XL, figs. 5, 6.

TOPOTYPE.—No. 24991; length 57.0 mm.; height 44.5 mm.; diameter (one valve) 22.0 mm.

Two specimens in the collection indicate that this species attains a size almost twice that indicated in the original description. The umbos in the adult form are but slightly anterior to the center of the dorsal margin and are definitely posterior to the anterior third of the shell.

The hinge as exposed in our specimens corresponds exactly with that of *Pleiorytis ovata* Conrad, 1862 (= *Petricola centenaria* Conrad, 1833) the monotypic species of *Pleiorytis* Conrad, 1862 (Acad. Nat. Sci., Phil. Proc. for 1862, p. 286) as figured by Gardner (1936, pp. 39–40, Pl. VI, figs. 3, 4), who has discussed the differences in habit which justify the recognition of this group as a generic entity separate from *Petricola,* a boring genus.

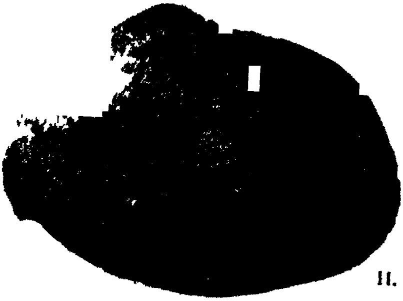
Psamosolen (?) **mansfieldi,** new species

Figure 13

HOLOTYPE.—No. 24995; length (slightly incomplete anteriorly) 49.0 mm.; height 16.0 mm.; diameter (one valve) 5.1 mm.

DESCRIPTION.—Shell of medium size, elongate, relatively thin; umbos low, inconspicuous, situated slightly posterior to the anterior third of the valve; dorsal and ventral margins sub-parallel, posterior broadly rounded, anterior broadly rounded ventrally, more sharply rounded dorsally; valve slightly gaping posterio-dorsally and posterio-ventrally, not gaping in the median posterior end; surface with a broad shallow inconspicuous median sulcus passing from the umbo to the ventral margin, and with a broad rounded ridge immediately posterior extending to the posterior ventral margin; the anterior and median portions of the valve smooth except for low concentric growth rugae; the posterior surface with shallow inconspicuous oblique grooves which tend to become obsolete on the posterior umbonal ridge and do not reach the ventral margin; hinge typical; pallial sinus tongue-shaped, deep, broad, rounded, extending forward slightly anterior to the middle of the valve.

P. (*?*) *mansfieldi* may be immediately distinguished from previously described species from this region by its much less strongly developed oblique sculpturing on the posterior portion of the valve, as well as by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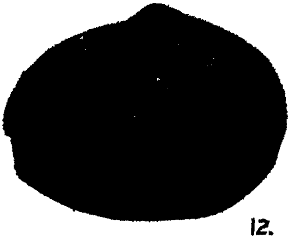
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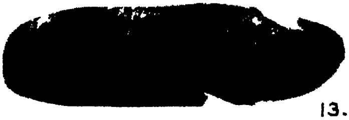
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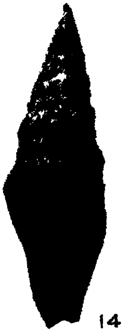
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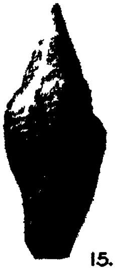
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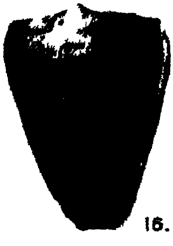
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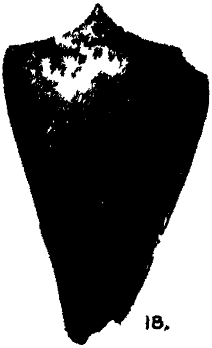
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Fig. 11. *Pleiorytis caroniana* (Maury). Topotype, No 24991; ×1.
Fig. 12. *Raeta meridionalis* Guppy. Topotype, No. 24993; ×1
Fig. 13. *Psamosolen* (?) *mansfieldi*, n. sp. Holotype, No. 24995; ×1.
Fig. 14. *Crassispira henekeni caroniana* (Maury). Topotype, No. 24996; ×1.
Fig. 15. *Mitra* (*Tiara*) *woodringi*, n. sp. Holotype, No. 24997; ×1
Fig. 16. *Conus* (*Lithoconus*) *couvaensis*, n. sp. Holotype, No. 24998; ×1.
Fig. 17. *Conus* (*Dendroconus*) *maga*, n. sp. Holotype, No. 24999; ×1.
Fig. 18. *Conus* (*Leptoconus*) *medialira*, n. sp. Holotype, No. 25000; ×1.

its more centrally located umbos and narrower, more elongate valves. It is only questionably assigned to the genus *Psamosolen* Risso due to the absence of a distinct posterior gape, in the right valve at least. A slight gaping is to be observed in the dorsal and ventral posterior margins. The anterior margin is somewhat incomplete but there appears to have been a well-developed gape in that region.

I take pleasure in naming this species in honor of Dr. W. C. Mansfield of the United States Geological Survey, student of the American and West Indian Miocene molluscan faunas.

Raëta meridionalis (Guppy)

Figure 12

Raëta meridionalis GUPPY, 1911, p. 201, Pl. II, fig. 1; Harris' reprint, 1921, p. 164 (312), Pl. XII, fig. 1.

Labiosa (*Raëta*) *gabbi* PILSBRY AND JOHNSON, 1917, p. 202; PILSBRY, 1921, Pl. XLVI, fig. 11

TOPOTYPE.—No. 24993; length 41.0 mm.; height 33.5 mm.; diameter (both valves) 23.3 mm.

Two specimens are in the collection. They agree well with Guppy's poor figure and with that of the Santo Domingo fossil of Pilsbry and Johnson. This species is closely related to the recent East Pacific form *Raëta undulata* Gould.

Maury (1925, p. 331, Pl. XLII, fig. 9) has figured an imperfect specimen from Springvale as *Thracia* (*Cyathodonta*) *meridionalis*, stating: "In *Raëta* the undulations are very finely transversely marked with vermiculate striae, but the Trinidad fossil has much coarser streaks, like those of a paint brush when the paint is too thin." In the specimens at hand these striae are so finely developed as to be almost imperceptible. Further, Dr. Maury's specimen appears to have much less inflated umbos which are more centrally located and the surface of the shell is marked by prominent, broad, concentric undulations, while our fossils have a concentric ornamentation which has the appearance of low, widely separated ridges. Insofar as can be determined from Guppy's figure, the surface ornamentation was of the latter type. A single poor specimen in the collection has the shape and apparently the same general ornamentation as that figured by Dr. Maury. However, it seems best to await better material before formally naming this form.

Pholadomya species

An imperfectly preserved specimen serves to record the presence of this relatively rare genus in the Springvale fauna. It seems to be of the general outline of *P. sawkinsi* Maury (1925, p. 333, Pl. XLII, fig. 10) but the details of the sculpturing more closely approximate that of *P. falconensis* F. and H. Hodson (1927, p. 44, Pl. XXVI, fig. 6; Pl. XXVII, figs. 1, 2).

Gastrochaena couvana, new species

Figure 8

HOLOTYPE.—No. 24990; length (slightly incomplete posteriorly) 17.2 mm.; height 8.8 mm.; diameter (left valve) 3.5 mm.

DESCRIPTION.—Shell small, slender, mytiliform, thin, widely gaping ventrally, less strongly gaping posteriorly, umbos nearly terminal, small, inconspicuous; acutely angulate anteriorly; sculpture of incrementals, crowded and somewhat rugose ventrally, hinge edentulous; myophore not preserved; pallial and adductor scars not observed.

G. couvana is distinguished from other described fossil and recent species in the narrower anterior portion of the valves. The umbos are more nearly terminal than in the recent species *G. cuneiformis* Spengler.

Conus (Leptoconus) medialira, new species

Figure 18

HOLOTYPE.—No. 25000; length 51.2 mm.; diameter 29.5 mm.

DESCRIPTION.—Shell of medium size, spire moderately high, concave in contour, shoulder truncate; nucleus smooth, rounded, erect, of two and one-half whorls; first two post-nuclear whorls tuberculate, the tubercles well developed at the nucleus and becoming progressively weaker; the subsequent volutions, eight to nine in number, excavated, marked only by growth lines; aperture broader anteriorly, outer lip moderately retractive, anal notch deep, siphonal notch weak, siphonal fasciole hardly discernible; lower part of body whorl marked by slightly irregular rounded spiral grooves separating flat-topped riblike spaces of approximately twice the width of the grooves, each with a median secondary groove.

Conus (*Leptoconus*) *stenostoma* Sowerby has a somewhat similar sculpture pattern on the body whorl, but differs markedly in its strongly retractive outer lip and in the shape and sculpturing of the spire whorls.

Conus (Lithoconus) couvaënsis, new species

Figure 16

HOLOTYPE.—No. 24998; length 33.7 mm.; diameter 23.5 mm.

DESCRIPTION.—Shell of medium size, spire low almost flat, shoulder angulate to sub-truncate; nucleus décolleté; post-nuclear whorls eight, deeply excavated on top, with a strong spiral ridge at the shoulder, otherwise lacking ornamentation; body whorl relatively short, broadly convex in outline, ornamented anteriorly by broad flat ribs which appear as if overlapping posteriorly; aperture broader anteriorly, outer lip moderately retractive, anal notch deep, siphonal notch shallow, siphonal fasciole slightly bulging.

The extremely low, almost flat spire, and the swollen convex outline of the body whorl serve to distinguish this species. *Conus veatchi* Olsson (1922, p. 216, Pl. v, figs. 5, 8) from the Middle Miocene Gatun Stage of Costa Rica has a somewhat similar shape. However, the body whorl is less inflated and the shoulder of the whorl is ornamented with ten to eleven fine spirals.

Conus (Dendroconus) maga, new species

Figure 17

Conus stenostoma SOWERBY, MAURY, 1925, p. 337, Pl. XLV, fig. 3. Not *Conus stenostoma* SOWERBY, 1850, Quart. Jour. Geol. Soc. London, VI, p. 44. See also MAURY, 1917, Bull. Amer. Paleo., V, p. 203, Pl. XXXII, fig. 4. WOODRING, 1928, p. 209, Pl. x, fig. 4.

? *Conus stenostomus* SOWERBY, GUPPY, 1910, pp. 4, 6. Harris' reprint, pp. 309, 311.

HOLOTYPE.—No. 24999; length 85.3 mm.; diameter 50.5 mm.

DESCRIPTION.—Shell large, spire relatively low, concavo-convex in outline, shoulder truncate; nuclear whorls décolleté; early post-nuclear volutions obscurely tuberculate, later whorls excavate above, marked by numerous fine microscopic striae which tend to be obsolete toward the outer edge, and by prominent lines of growth; aperture widened anteriorly, slightly flaring; outer lip moderately retractive, anal notch deep; siphonal notch wide, shallow; siphonal fasciole relatively wide; anterior portion of body whorl sculptured by irregularly spaced, rounded spiral threads which are obscurely beaded.

This species may be distinguished from *C. stenostoma* Sowerby, with which it has been confused, by the more deeply excavate anal fasciole, the finer spiral sculpturing on the spire whorls, the nature of the sculpturing on the anterior portion of the body whorl, and by the wide, shallow siphonal notch and the wide siphonal fasciole. *C. apium* Woodring (1928, p. 202, Pl. IX, fig. 3) has a lower spire, more rounded shoulder and less deeply excavate anal fasciole. *C. haitensis* Sowerby has a lower spire which is conspicuously striate spirally.

Conus species

The single imperfect specimen is distinguished by the slender body whorl which is twice the length of the diameter of the shell. The spire was apparently relatively high, the shoulder sharply angulate, smooth and but slightly concave above. The outer lip is sharply retractive and the anal notch deep. The anterior portion of the body whorl is marked by broad flat ribs separated by narrow sharp interspaces.

This form resembles *Conus furvoides* Gabb from the Miocene of Santo Domingo (see Pilsbry and Johnson, 1921, p. 328, Pl. xx, fig. 1), but differs in possessing a more strongly retractive outer lip, a deeper anal notch, and the outer lip does not appear to have been so strongly flaring anteriorly.

Woodring (1928, p. 211) points out that "the cone from the Upper Miocene Beds at Springvale, Trinidad, described by Maury as *planiliratus* (see Maury, 1925, p. 338, Pl. XLV, fig. 6) lacks spirals on the anal fasciole and has widely spaced, narrow spiral grooves on the body whorl." It is not *C. planiliratus* Sowerby,[1] but not being represented in the collection it cannot be described here.

Cancellaria (Cancellaria) couvana, new species

Figure 21

HOLOTYPE.—No. 24667; length 32.2 mm.; diameter 20.5 mm.

DESCRIPTION.—Shell of medium size, of two and one-half smooth naticoid nuclear whorls and six and one-half post-nuclear volutions; first post-nuclear whorl strongly convex, with four spiral threads and fifteen moderately retractive axials, beaded at the junction with the spiral ribs; on the second whorl a fine secondary spiral appears near the suture and another between the second and third primary ribs; the four anterior spirals become heavy, the other two near the suture are of secondary strength, the whorl becoming angulate at the posterior heavy spiral on the third post-nuclear volution and developing a flat-topped shoulder on the penultimate whorl; suture appressed on the spire whorls, deeply excavate on the body whorl: penultimate whorl marked with fourteen broad, rounded axials which form prominent nodes on the shoulder spiral; body whorl with thirteen spirals, the two on the shoulder of secondary strength, a third of primary strength forms the carinated shoulder angle and is strongly nodose to spinose at the junction with the broad, low axials; aperture moderately long, lunulate; outer lip with thirteen sharp lirae which are reduced to eight deep within the aperture; inner lip with a thin callus wash through which the spirals appear posteriorly; columellar plications typical; anterior canal short, siphonal notch shallow; siphonal fasciole high, with five low, inconspicuous spiral threads; a shallow umbilical groove occurs between the fasciole and the edge of the callus.

C. couvana resembles *C. venezuelana* Hodson (1931, p. 45, Pl. XXIII, figs. 1, 4) in its strongly carinated shouldered whorls, but differs in the absence of secondary ribbing on the body whorl and in the number of axial riblets on the spire whorls. *C. springvaleënsis* Mansfield (1925, p. 31, Pl. II, fig. 12) does not possess the sharp carinated shoulder, has a shorter, proportionately broader aperture, and the callus wash is thinner with stronger columellar plications.

Maury's Springvale record of *C. epistomifera* Guppy (1925, p. 345, Pl. XLVI, fig. 7) is based upon "a single young, and somewhat crushed specimen." The figure is very poor, but insofar as it can be interpreted seems to represent *C. springvaleënsis* Mansfield.

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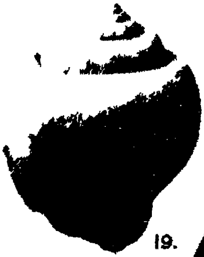
[1] Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 44.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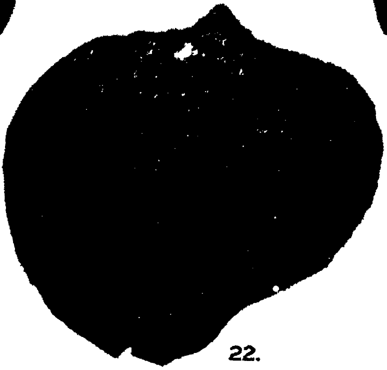
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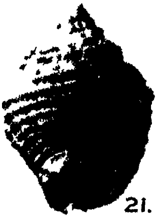
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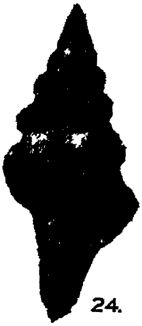
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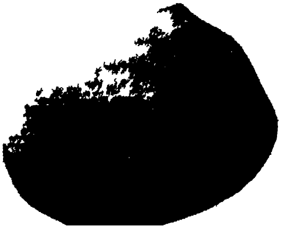
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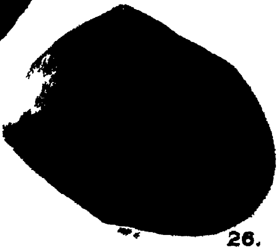
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Figs. 19, 20. *Cancellaria (Cancellaria) auriculaperta*, n. sp. Holotype, No. 24665; ×1.

Fig. 21. *Cancellaria (Cancellaria) couvana*, n. sp. Holotype, No. 24667; ×1.

Figs. 22, 23. *Semicassis (Tylocassis) maleaformis*, n. sp. Holotype, No. 24679; ×1.

Fig. 24. *Latirus (Polygona) infundibulum* cf. *polius* Woodring. Hypotype, No. 25001; ×1.

Figs. 25, 26. *Sinum naticoidalis*, n. sp. Holotype, No. 25002; ×1.

Cancellaria (Cancellaria) auriculaperta, new species

Figures 19, 20

Holotype.—No. 24665; length 36.8 mm.; diameter 27.0 mm.

Description.—Shell moderately large, inflated, spire low, nucleus décolleté, smooth; post-nuclear whorls six, tabulate; early whorls ornamented with numerous broad, rounded axial ribs separated by interspaces of equal width, and with about seven low, rounded spirals which are not as strongly developed as the axials; on the later spire whorls the axials tend to disappear and are wholly absent on the penultimate and ultimate volutions, the spiral cords likewise become obsolete, the body whorl being smooth save for many fine striae and nine or ten low, rounded spirals on the base; aperture lunate, wide, slightly flared and notched posteriorly; outer lip flaring at the distinct stromboid notch, interior with 19 low lirae, anterior canal short; inner lip with a heavy parietal callus; columella triplicate, the posterior plication well developed, deep within the aperture, nearly horizontal, situated anterior to the posterior margin of the siphonal fasciole, and separated from the anterior plications by an elongate bead-like denticle: anterior plications extending almost to the edge of the callus; siphonal fasciole strong, bulging, sub-angulate posteriorly.

Cancellaria auriculaperta resembles *C. laevescens laevescens* Guppy and *C. l. portoricana* Maury in the reduction of the sculpturing on the body whorl. It may be readily distinguished from these species by the absence of sculpturing on the penultimate as well as on the body whorl. The spire is lower, the aperture longer and wider with a greater number of lirae on the inner lip and less strongly developed columellar plications, the posterior of which does not extend to the edge of the callus.

C. scheibei Anderson (1929, p. 115, Pl. x, figs. 1, 2, 3, 4) from the Miocene of Colombia is more inflated and has a less strongly developed shoulder. *C. cibarcola* Anderson (1929, p. 116, Pl. xiv, figs. 1, 2, 3) is apparently a related species, but differs in possessing more strongly developed spiral sculpturing on the spire whorls resulting in a "disposition toward a truly cancellated sculpture in the young stages." The columella has two elongate denticles between the posterior and the more anterior plications.

Mitra (Tiara) woodringi, new species

Figure 15

Holotype.—No. 24997; length 37.8 mm.; diameter 14.0 mm.

Description.—Shell of medium size, moderately inflated, of nine post-nuclear whorls; nucleus smooth, somewhat décolleté; spire whorls convex, ornamented by five revolving ribs which on the early volutions are separated by narrow linear interspaces cancellated by lines of growth; later whorls somewhat shouldered with a low riblet at the slightly excavate suture; sculpture on the body whorl consisting of three strong, distant spirals anterior to the sutural rib, the median one forming the slight shoulder of the whorl, anterior are four slightly weaker ribs separated by interspaces of approximately equal width; base of whorl moderately constricted, marked by eight ribs which are more finely developed posteriorly and become progressively heavier and more distant anteriorly; growth lines prominent only on the early post-nuclear whorls; aperture elongate, outer lip simple, inner lip with a thin callus wash marked with three strong folds and a fourth minor fold deeply set within; siphonal fasciole strongly developed, bulging; siphonal notch deep.

This species somewhat resembles *M. sancti-francisci* Maury (1925, p. 356, Pl. XLVI, fig. 13) which also occurs at Springvale, but may be readily distinguished by the absence of the central constricted region on the ultimate whorl. The Costa Rican species, *M. limonensis* Olsson (1922, p. 272, Pl. IX, fig. 1) is a more slender form with a higher spire which differs in the details of the sculpturing. The specimen figured by Weisbord as *Mitra* cf. *limonensis* (1929, p. 280, Pl. XLI, fig. 13) is more closely related. Our species seems to be slightly more inflated, has but a single riblet near the suture and the anterior canal is somewhat longer.

This species is named in honor of Dr. W. P. Woodring of the United States Geological Survey.

Latirus (Polygona) infundibulum Gmelin cf. **polius** Woodring

Figure 24

Latirus (*Polygona*) *infundibulum polius* WOODRING, 1928, p. 253, Pl. XV, figs. 4, 5.

HYPOTYPE.—No. 25001; length 45.8 mm.; diameter 18.5 mm.

Six specimens in the collection agree with the Bowden subspecies in being considerably smaller than typical *L. infundibulum* and in having more prominent ribbing. Three of the specimens possess nine axials and three show eight, being somewhat intermediate between *L. i. infundibulum* and *L. i. polius* in this respect.

Fusinus springvalensis (Maury)

Figures 27, 28

Fusus springvalensis MAURY, 1925, p. 358, Pl. XLVI, fig. 11.

TOPOTYPES.—No. 24671; length 92.4 mm.; diameter (slightly distorted) 33.0 mm. No. 24690; length 126.5 mm.; diameter 42.5 mm.

The two topotypes in the collection, while both incomplete, are nevertheless more satisfactory than the holotype as figured by Dr. Maury. They indicate that the relative strength or the presence or absence of axial ribbing on the later whorls is not a diagnostic feature. Topotype 24690 possesses strong axial ribbing on the early post-nuclear whorls. This ribbing becomes obsolete on two and one-half turns and then reappears suddenly as sub-equal nodose swellings on the middle of the whorl. These persist for approximately one volution, but are again obsolete on the penultimate and ultimate whorls. On topotype 24671 swollen axials persist on all the spire whorls but are absent on the body whorl.

The most distinctive feature of this species is the presence of inter-ribbing between most, but not all the primary spirals. The spirals are essentially triangular in section and are all marked by fine, microscopic striae, which are also present in the interspaces.

Fusinus magdalenensis Anderson (1929, p. 133, Pl. xv, figs. 1, 2, 3) seems to be closely related.

Cassis, species aff. **tuberosa** Lamarck

Fragments including much of the callus of the inner lip, the basal portion of the body whorl, and the thickened outer lip complete nearly to the shoulder have a height of 210 mm. and indicate that the specimen complete must have been about 250 mm. high. The principal differences separating the recent species *C. tuberosa* Lamarck from the more common Miocene species *C. sulcifera* Sowerby are the larger size and the finer axial ribbing of the former species. The specimen at hand seems to have been approximately two and one-half times the size of normal specimens of *C. sulcifera* and is therefore tentatively referred to *C. tuberosa.*

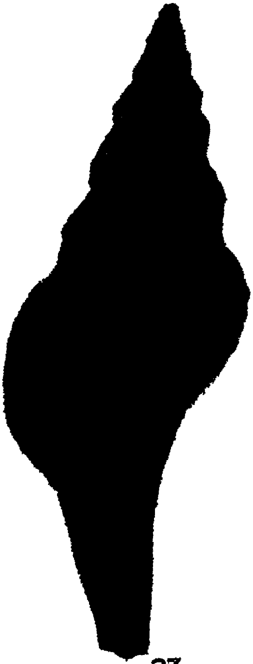
Semicassis (Tylocassis) maleaformis, new species

Figures 22, 23

HYPOTYPE.—No. 24679; length 56.7 mm.; diameter (somewhat crushed) 51.0 mm.

DESCRIPTION.—Shell moderately large, inflated, spire relatively low; nucleus smooth, naticoid, of about two and one-half whorls; post-nuclear whorls five, those preceding the penultimate whorl angulate at the shoulder, sculptured with six spiral threads cancellated by numerous retractive axials; penultimate and ultimate whorls marked by broad spiral bands; aperture lunulate, wide, outer lip strongly thickened forming a prominent varix with strong lirate denticulations on the inner edge; inner lip with a heavy callus detached at the base but fused to the body whorl above; basal region of callus with many denticles; parietal wall with numerous ridges; base of aperture deeply emarginate forming a short canal, strongly twisted; siphonal fasciole broken, apparently greatly inflated.

The only specimen is somewhat distorted and crushed, but is so unique as to merit description. Its gross shape and the general sculpturing of the ultimate and penultimate whorls strongly resembles that of *Malea camura* Guppy. It most nearly approaches *S. inflata* (Shaw) but may be distinguished from that species by the lower spire and the lack of any axial sculpturing on the penultimate and body whorls.



27.

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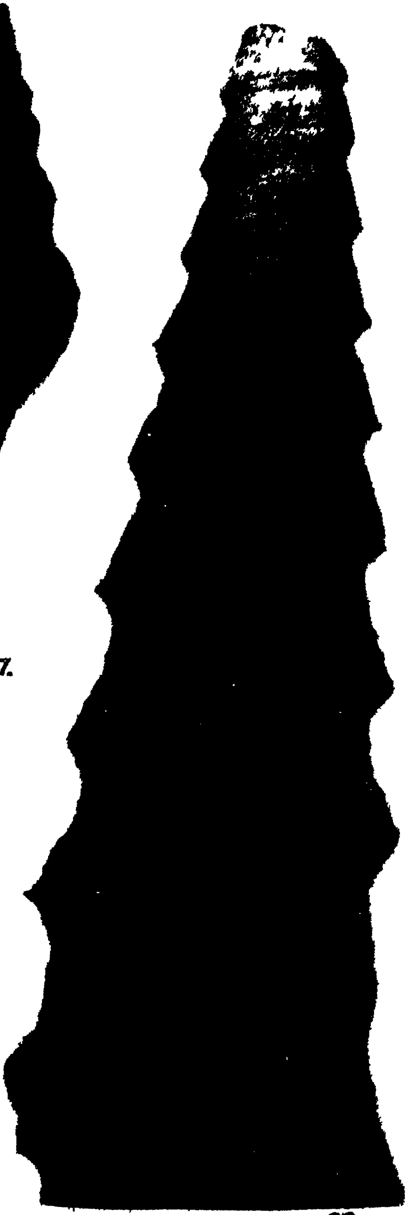

29.

Fig. 27. *Fusinus springvalensis* (Maury). Topotype, No. 24671; ×1.
Fig. 28. *Fusinus springvalensis* (Maury). Topotype, No. 24690; ×1.
Fig. 29. *Turritella trinitaria* Maury. Topotype, No. 24697; ×1

Ficus carbasea (Guppy)

Ficula carbasea GUPPY, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 580, Pl. XXVI, fig. 7. GUPPY, 1910, pp. 452, 456; Harris' reprint, 1922, pp. 297, 300.

Pyrula carbasea GUPPY, MAURY, 1925, p. 376, Pl. LII, fig. 5.

Pyrula trinitaria MAURY, 1925, pp. 374–5, Pl. LII, figs. 9, 12.

Ficus carbasea GUPPY, WOODRING, 1928, p. 314.

A number of well-preserved specimens in the collection show great variation in the characters used to distinguish "*Pyrula*" *trinitaria* Maury from *Ficus carbasea,* and indicate that that species cannot be considered more than varietally distinct from Guppy's species. According to Guppy this latter was described from "Savanetta, Trinidad," "(Caroni Series)" and not from Springvale as stated by Woodring.

Turritella trinitaria Maury

Figure 29

Turritella trinitaria MAURY, 1925, p. 382, Pl. LIII, fig. 10.

Turritella robusta GRZYBOWSKY var. *fredeai* HODSON, 1926, Bull. Amer. Paleo., XI, p. 183, Pl. IX, figs. 1, 3; Pl. X, figs. 2, 5; Pl. XI, figs. 1, 6, 7; Pl. XIII, fig. 7; Pl. XXXIII, fig. 6.

Turritella abrupta SPIEKER, ANDERSON, 1927, Proc. Calif. Acad. Sci., XVI, p. 89. Not *T. robusta* var. *abrupta* Spieker, 1922, Johns Hopkins Univ. Publ. Geol., No. 3, p. 85, Pl. IV, fig. 6.

Turritella supraconcava HANNA AND ISRAELSKY var. *fredeai* HODSON, WEISBORD, 1929, p. 263, Pl. XLIV, figs. 3, 4.

Turritella fredeai HODSON, ANDERSON, 1929, p. 119, Pl. XVII, fig. 1.

TOPOTYPE.—No. 24697; length 194.0 mm.; diameter 55.4 mm.

Well preserved, adult topotype material indicates that *T. fredeai* Hodson, the well-known Venezuelan and Colombian species is synonymous with this Springvale form which was described on fragmentary material.

Grzybowsky's name *T. robusta* being preoccupied by Gabb for a California fossil has been renamed *T. supraconcava* by Hanna and Israelsky (1925, Proc. Calif. Acad. Sci., XIV, p. 59).

Capulus (Malluvium), species

A single small, moderately inflated, elongate-ovate specimen is in the collection. The apex lies far to the rear, the nucleus forming a dextral coil which extends slightly beyond the rear of the apertural opening. The surface is smooth save for lines of growth. The interior of the shell and the muscle scar have not been observed.

Capulus effluens Guppy (1911, pp. 197, 199) is not a *Malluvium.*

Listed by Guppy as *Capulus*, it was described as a *Cadulus*. The description indicates that the former is the correct generic reference.

Sinum naticoidalis, new species

Figures 25, 26

HOLOTYPE.—No. 25002; length 36.5 mm.; diameter 39.0 mm.

DESCRIPTION.—Shell large, thick, moderately inflated, not flattened, spire slightly elevated; nucleus décolleté, whorls rapidly enlarging, sculptured with numerous fine primary spirals separated by interspaces of slightly greater width each of which bears a thread-like secondary spiral; aperture wide, almost circular, inner lip with a thin callus, slightly reflected to form a small umbilical chink.

S. naticoidalis is unique among the Miocene species of this genus from the West Indian region. The high shell showing no evidence of being flattened is approached only by the Dominican species *S. nolani* Maury, which, however, is almost smooth. The shape of the aperture is reminiscent of *S. excentricum* Guppy, but that species is somewhat flattened and possesses a spiral sculpture of three orders of magnitude.

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AMERICAN MUSEUM NOVITATES

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A NEW MARSUPIAL FROM THE EOCENE OF PATAGONIA[1]

By George Gaylord Simpson

In preparing a collection principally of bird bones made in Patagonia by the First Scarritt Expedition, there was recently found in the matrix a small mammalian jaw. Imperfect as it is, this specimen proves to be identifiable and to represent a new, unexpected, and important element in the Eocene fauna of South America.

The deposit from which this comes is an exposure of green bentonite, in the Casamayor Formation, in Cañadón Hondo, Chubut, Argentina, a remarkable fossil pocket only a few feet in diameter but rich in bones of highly varied character. The facies is unlike anything otherwise known in South America, all the fossils found in it appear to be new, and with a single exception none of the species, or probably genera, has ever been found except in this one minute spot in central Patagonia.

The fossils belong to four different vertebrate classes, including an anurous amphibian (being studied by Dr. G. K. Noble), two very unusual reptiles (*Sebecus* and *Crossochelys*, see Simpson, 1937), many but probably not highly varied bird bones (being studied by Dr. A. Wetmore), and the mammal described in this paper.

The accompanying illustration was drawn by Mr. John C. Germann, and I again have to thank Mr. Albert Thomson for his great skill in preparation. In this case he actually found the specimen, as well as prepared it, for it was collected accidentally in a block of matrix surrounding other and much larger bones and would never have been seen did he not work with such care.

COÖNA,[2] NEW GENUS

TYPE.—*C. pattersoni*, new species.

DISTRIBUTION.—Casamayor Formation, Eocene, Patagonia.

DIAGNOSIS.—Small didelphids with lower jaw and dentition of generally didelphine aspect. P_3 (alveoli) about as large as M_1. M_3 (probably also $_{1-2}$) with talonid markedly wider than trigonid, paraconid slightly higher than entoconid, metaconid intermediate between paraconid and protoconid, trigonid moderately elevated and not compressed, hypoconulid very small, nearly internal, near entoconid. Talonid of M_4 as wide as trigonid or slightly wider and of about the same area, fully basined and closely similar to that of M_3, with three quite distinct cusps, the hypoconulid not enlarged or produced but about as on M_3. M_4 as a whole smaller than M_3.

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[1] Publications of the Scarritt Expeditions, No. 31.

[2] *Koona* (*fide* Musters), *cône* (Schmid), or *coòna* (alternative transcription of indicated root), "stream" in the Tehuelche (Patagonian) language, in allusion to the evidently fluviatile or palustral associations of the type.

Coöna pattersoni,[1] new species

TYPE.—Amer. Mus. No. 28907, right lower jaw with alveoli of P_4–M_2, whole crown of M_3, and M_4 with trigonid broken. Collected by C. S. Williams and G. G. Simpson, March 1931.

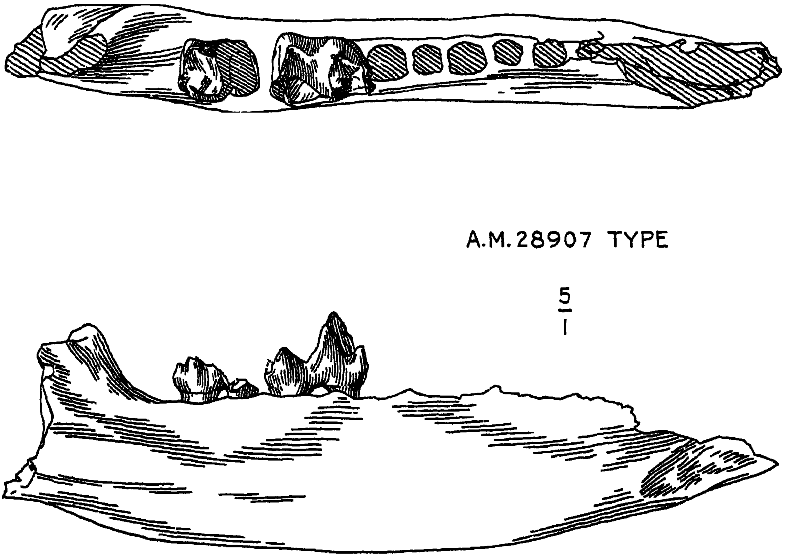

Fig. 1.—*Coöna pattersoni*, new genus and species. Type, Amer. Mus. No. 28907, left lower jaw with M_3 and talonid of M_4. Crown and internal views. Five times natural size.

HORIZON AND LOCALITY.—Casamayor, green bentonite series at type locality of *Sebecus icaeorhinus*, *Crossochelys corniger*, etc., in Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—Sole known species of *Coöna*.

The alveoli show that P_3 was about as long as M_1 and nearly as wide. M_1–M_3 were progressively larger, and M_4 abruptly smaller, perhaps about the size of M_1. The posterior alveoli of M_{1-2} are noticeably larger than the anterior, and the preserved crown of M_3 shows the reflection of this in the wide talonid. As in most didelphids, this tooth has oblique anterior and posterior cingula, the latter running into the hypoconulid. The other dental characters are adequately represented in the diagnosis and the figure.

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[1] Bryan Patterson, in recognition of his fine work on South American fossil mammals.

The jaw is slender, simple, and much as in other small didelphids. The long, open symphysis reaches nearly to the anterior end of P_3. There is a mental foramen beneath the posterior root of M_1. On the outer side of the ramus beneath M_3 there is a prominent oblique groove, evidently pathological or a postmortem injury.

Didelphids, although forming a very small fraction of the collections, are well represented in various South American faunas from the Colhué-Huapí Formation (probably latest Oligocene) to the recent. Before the Colhué-Huapí the only records have been *Ideodelphys microscopicus* Ameghino and *Proteodidelphys praecursor* Ameghino, each represented only by a single specimen.[1] The latter was supposed to be from the Cretaceous "areniscas abigarradas" but I have elsewhere shown (Simpson, 1932) that there is no credible evidence of this, that the specimen is morphologically indistinguishable from mid-Tertiary forms, and that everything suggests that it is, in fact, from the mid-Tertiary.[2] In any case it cannot be accepted as of greater age and should, lacking any confirmation, be omitted from considerations of marsupial history.

Ideodelphys is unquestionably from the Casamayor and has therefore been the oldest South American didelphid of believable record. Unfortunately it is practically unidentifiable, being based on a broken jaw without any teeth. It is possible or indeed probable that this jaw did belong to a didelphid but the light that it casts on the history of that group is negligible, to say the least. Even if it were known positively to belong in the Didelphidae, its affinities within the family are beyond conjecture. Since its minute jaw is much smaller than that of *Coöna pattersoni* and since the alveoli have quite different proportions it is certain that the species are distinct and all but certain that the genera are.[3]

Coöna is thus really the only definable South American didelphid known to be from beds older than the Colhué-Huapí. Its most surprising and important characteristic is that it is definitely not a member of the Microbiotheriinae, the subfamily to which all the other defined South American didelphids older than the Pliocene belong. As I have elsewhere pointed out (Simpson, 1935), M_4 of the microbiotheres is very distinctive because it is markedly reduced in size and has a very narrow, nearly unbasined heel, with only one really distinct, posteromedian cusp. M_4 of *Coōna* not only does not have these talonid characters, but also suggests an even greater difference from them than is seen in the Didelphinae, for instance, because the latter do commonly have the talonid of M_4 narrower than the trigonid and with a relatively large and posteromedian hypoconulid. The microbiotheres also appear usually or always to have the hypoconulid of M_3 (and the more anterior molars) more median than in *Coōna* and more coördinate with the hypoconid and entoconid as an element of the talonid rim.

---

[1] We have a second specimen of *Ideodelphys* but it adds nothing to what was known from the type.

[2] It was not found by Carlos Ameghino, who would not have made such an error, but by a worker whose field data are not reliable. Scott (1937) has recently compromised the argument by assigning the specimen to the Río Chico, which is practically impossible, or at least is contrary to all the evidence and claims on either side.

[3] In any case there would be no excuse for referring our species to *Ideodelphys* simply because it cannot be absolutely proved not to belong to it—in that case all opossums described since 1902 would have to be referred to *Ideodelphys* since none of them can be rigidly proved not to belong to it. *Ideodelphys* is what I call a *nomen vanum*, that is, it is not technically a *nomen nudum* and in general complies with the artificial requirements of the International Rules, but in practice it is quite valueless and is simply a nuisance because the genus never has, in fact, been distinguished, cannot be at present, and probably never will be.

In a general way *Coōna* compares rather with the Cretaceous Pediomyinae and the earlier Tertiary Didelphinae of North America than with the Microbiotheriinae. I am not, however, acquainted with any pediomyine that has exactly the structure and proportions of M_3 seen in *Coōna* nor with any pediomyine or didelphine that is known to have a closely similar M_4. *Peradectes elegans*, a didelphine from the Tiffany, Upper Paleocene, of North America seems to compare as closely with *Coōna pattersoni* as does any other previously known form. Its M_3 is very similar, differing only in minute details of doubtful value, such as the facts that the entoconid does not so nearly reach the height of the paraconid and that the disparity in width between trigonid and talonid is less marked. The talonid of M_4 is, however, definitely unlike that of *Coōna* and more like that of the later true didelphines, being somewhat elongate, narrower, and with a projecting hypoconulid which is the highest talonid cusp.

As hitherto known, the most probable interpretation of the history of the modern opossums has been as follows. In the Cretaceous of North America (and very likely also on other continents, although not yet discovered elsewhere) opossums were very abundant and extraordinarily varied. Probably from one group of these, the relatively unspecialized Pediomyinae, arose the didelphine stock, also varied as regards very minor characters but extraordinarily unprogressive and stereotyped in basic morphology. These occurred in the older Tertiary in Europe, but died out there in the Miocene. In North America they are known from the Paleocene to the Miocene and again in the Pleistocene and Recent. It is probable that their apparent absence toward the end of the Tertiary is merely caused by non-discovery, that they lived in North America continuously, and that the living genus *Didelphis* was autochthonous here. In South America the known Middle Tertiary forms are microbiotheres and could not be ancestral to the living South or North American opossums. Opossums of recent type appear with apparent suddenness in the later Tertiary of South America and it seemed probable that they were invaders from the North American didelphine stock, making entry in advance of the major wave of continental intermigration.

As regards *Coöna*, three possibilities are worthy of special consideration:

1.—that it is an ancestral microbiothere, these animals becoming typically developed only toward the middle Tertiary;

2.—that it is an ancestral didelphine and that these modern opossums did develop in South America instead of or as well as in North America despite their nondiscovery in the Middle Tertiary, which after all, is represented only by faunas very limited facially and geographically; or

3.—that it is simply another offshoot of the generalized opossum-like, perhaps pediomyine, stock that must have entered South America sometime before the Eocene, and represents an extinct minor phylum ancestral neither to microbiotheres nor to recent didelphines.

This one specimen, so incomplete and so vastly isolated in space and in time, certainly can make possible no definite choice between these alternatives, and any one of them remains possible. Such as it is, however, the evidence favors the third view. As noted above, the known peculiarities of *Coöna* hint at a trend rather away from than toward the microbiotheres. Although it is, in the known parts, rather more didelphine- than microbiothere-like, it seems in these parts to be slightly less fit morphologically as an ancestor of living opossums than are contemporary and older North American forms.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. No. 19

ON SOME NON-PASSERINE NEW GUINEA BIRDS

BY A. L. RAND

The following species have been selected for notice from those studied in the collection of the 1936 New Guinea Expedition. Time has not permitted a complete study of the collection and as I expect to return to New Guinea soon with the 1938 New Guinea Expedition it is advisable to publish this material now.

Descriptions of five new races from south New Guinea and one from north New Guinea are included. I have been favored with advice from Dr. E. Mayr while working up this material.

Anhinga rufa papua, new subspecies

TYPE.—No. 447417, Amer. Mus. Nat. Hist.; ♀ ad.; Lake Daviumbu, middle Fly River, south New Guinea; September 3, 1936; Richard Archbold, A .L. Rand, G. H. H. Tate.

DIAGNOSIS.—Differs from *A. r. novaehollandiae* in the female in the darker colored upperparts, with a reduction of the light markings; the top of the head and the back of the neck being darker with the brownish edgings much reduced and the dark color of the back of neck extending farther onto the sides; the fore back being more glossy black, with very reduced and darker brownish edgings; the scapulars, inner secondaries and wing-coverts having the gray markings much reduced in size and darker in color. In the male the neck and fore back is blacker, with less brown, but the light markings in the scapulars and wing-coverts are little smaller than in some of the Australian specimens.

WING MEASUREMENTS

	MALE	FEMALE
Australia	340, 349, 350, 353, 353, 357 362, 363, 367	342, 343, 352
New Guinea	351	332, 336, 346

DISTRIBUTION.—New Guinea and Fergusson Island.

REMARKS.—The New Guinea male comes from near Madang, the females from Lake Daviumbu and Fergusson Island. The adult females of this race, as with *A. r. novaehollandiae*, have white underparts.

Xenorhynchus asiaticus australis (Shaw)

Daru: 1 ♀ imm.; March 22, 1936.

Wing: 602.

The specimen, probably belonging to this form, is in immature plumage with a few iridescent feathers in the plumage of the head.

Though this species has not been collected on the mainland of New Guinea, Dr. Nevermann (1935, Mitt. Zool. Mus. Berlin, XX, p. 454) saw it several times on the coast of south New Guinea in 1933 and I made the following sight records in 1936:

Penzara: A single adult was seen standing in the edge of the water hole there on Dec. 18 and a black and white tail feather belonging to this species was picked up on the savanna.

Daru: During March three birds in immature plumage were occasionally seen soaring about over the island or feeding on an area on the coast where the mangroves had been cut.

Gaima: A pair of adult birds flew in and lit on the open marsh near Gaima on November 15.

Lake Daviumbu: Two adult birds were seen on different occasions in September, standing on the edge of lagoons in the savanna country. Twenty miles above Lake Daviumbu, on August 16, a single adult was seen soaring about over the lagoon country.

Notophoyx novaehollandiae (Latham)

Mabaduan: 1 ♀ ad.; April.

Daru: 2 ♂ ad., 1 ♀ ad.; March 12, April 26.

Wing: ♂ 318, 320; ♀ 297, 308.

Stresemann and Paludan (1935, Mitt. Zool. Mus. Berlin, XX, p. 454) were the first to record this species for New Guinea. I collected it at Daru in 1934 (1937, Bull. Amer. Mus., LXXIIL, p. 6).

Though not recorded for New Guinea until 1935 there is in the American Museum collections an immature specimen from the Hydrographer Mountains collected by Eichorn Brothers in 1918.

Egretta intermedia plumifera (Gould)

Lake Daviumbu: 1 ♂, 1 ♀; August 20, September 6.

Wing: ♂ 286; ♀ 284.

This species has been recorded twice from near Merauke (Bangs, O., and Peters, J. L., 1926, Bull. Mus. Comp. Zoöl., LXVII, p. 242: Stresemann, E., and Paludan, K., 1935, Mitt. Zool. Mus. Berlin, XX, p. 454) and once from north New Guinea at Ifaar (Hartert, E., 1930, Nov. Zool., XXXVI, p. 111). It was a very common species at Lake Daviumbu, feeding in flocks up to 75 and 100 in number on the extensive beds of half submerged rice grass in the lagoons. They were wary and when flushed flew to light in trees on the edge of the lagoon, or to another part of the marsh. Probably it was this species that I saw in flocks in the swamps at Gaima, where I was unable to procure specimens.

Neither specimen was breeding; one had a small fish in its stomach.

Ixobrychus minutus dubius Mathews

Lake Daviumbu: 1 ♀ ad.; September 13, 1936.

Wing: 123.

This is the first record of this species for New Guinea and, as might be expected in south New Guinea, it appears to be the Australian race. There are no females from Australia available for comparison, but compared with a series of males it is even smaller (5 ♂ ad. from Australia have wing of 130, 131, 133, 135, 141) and has the upper wing-coverts partly chestnut brown as do they.

This female was nearly ready to lay. Another bird, presumably its mate, was seen with it but could not be collected.

Circus species ?

Lake Daviumbu: 1 ♀ imm.; September 8, 1936.

Wing: 391.

Parts: iris brown; bill black, base gray, cere greenish yellow; feet yellow; nails black.

Pending the completion of a revision of the marsh hawks of this area, I prefer to list this specimen simply as *Circus*. It is worthy of record that silvery adult males, adult females and immature plumaged birds were not uncommon during our stay at Lake Daviumbu in August and September. During any morning spent on the marshes one or more birds were seen, beating about over the marsh or savanna in typically *Circus* fashion. They were very wary. A single male was seen near Gaima in November. The specimen had the right ovary present and about equal to the left in size.

Falco longipennis longipennis Swainson

Daru: 2 ♀; March 28, June 28, 1936.

Lake Daviumbu: 2 ♀; August 26, 28, 1936.

Wing: 260, 264, 267, 268.

The little falcon was first recorded for New Guinea by Hartert in 1932 (1932, Nov. Guinea, XV, p. 446). Stresemann (1934, O. M. B., XLII, p. 157) has recorded it for New Britain. It is probably a migrant from Australia; none of the specimens showed signs of breeding. Those collected were the only ones seen; they were in savanna country or over open marsh. Stomach contents of two birds were as follows: (1) 4 adult bats and one young small bat; (2) large winged ants.

Uroaetus audax (Latham)

Gaima: 1 ♀ ad., 1 ♀ imm.; November 13, 14, 1936.

Wing: ♀ ad. 550; ♀ imm. 558.

The adult is molting from a worn brownish-black plumage into a fresh black plumage. The immature bird had a small right ovary, the adult did not.

This is the second record of the wedge-tail eagle for New Guinea. I found it fairly common at Dogwa in 1934, but in 1936 besides the two collected only one other, an adult, was seen at Gaima, and none elsewhere, though I expected to find it on the Wassi Kussa River.

Gymnocrex plumbeiventris hoeveni (Schlegel)

Fly River, 5 miles below Palmer Junction: 1 ♂, 2 ♀, May 23–30.

Wing: ♂ ad. 192; ♀ ad. 187, 196.

These three specimens are similar to a Setekwa River bird and these four south New Guinea specimens differ from specimens from Astrolabe Range, Dampier Island, Gobi (N. E. Papua), Waigiu and the Moluccas in the duller gray underparts washed with rufous brown, in the duller reddish brown of the breast, in having a conspicuous admixture of gray in the throat; the top of the head and back of the neck not clear rich rufous brown but duller and washed with dark olive, the rump and tail less blackish, and the rufous of the primaries duller.

The richly colored bird is undoubtedly *plumbeiventris* (type locality Misol). I have no material from the Aru Islands, but very possibly Aru Island birds are the same as the south New Guinea birds. As there is a name available (*hoeveni* Schlegel), for the Aru Island birds, I have provisionally referred the present specimens to that race.

Megacrex inepta pallida, new subspecies

TYPE.—No. 545676, Amer. Mus. Nat. Hist.; ♀ ad.; Hol, Humboldt Bay, New Guinea; August 10, 1928; E. Mayr.

DIAGNOSIS.—Differs from typical *inepta* in the paler, more buffy not brownish or vinaceous brown sides of the lower neck and sides of the body; the much paler flanks, the feathers tipped and washed with light brown instead of being dark rufous brown; and slightly lighter brown of rump, upper tail-coverts and primaries.

MEASUREMENTS.—Two females from north New Guinea have wings of 176 and 182; three females from south New Guinea, 174, 175, 181.

RANGE.—Recorded only from Humboldt Bay.

MATERIAL.—*M. i. pallida,* 2 ♀, Hol, Humboldt Bay; *M. i. inepta,* 1 ♀, Fly River, east bank opposite Sturt Island, 1 ♀, Bivak Island, 1 ♀, Launch Camp, Setekwa River.

REMARKS.—The two Hol birds, and one from the Setekwa River, have little vinaceous tinge on the fore neck; the other two birds from south New Guinea have it pronounced.

Irediparra gallinacea novaehollandiae (Salvadori)

Lake Daviumbu: 1 ♂ imm., 1 ♀ ad., 2 ♀ imm.; August 28–September 4, 1936.

Wing: ♀ ad. 143.

As was to be expected, these belong to the pale Australian race which I collected for the first time in New Guinea in 1934, near Daru (1937, Bull. Amer. Mus., LXXIII, p. 26).

The jacana was fairly common at Lake Daviumbu, and was breeding in August and September, as the natives brought me a number of eggs obviously of this species.

Choriotis australis (Gray)

In 1934, Mr. Beach of Daru told me of shooting one of these birds in the Wuroi savanna years before (1937, Bull. Amer. Mus., LXXIII, p. 25). On the 1936–1937 Expedition, though I was unable to secure a specimen, Brass saw one on January 7 and I saw one, presumably the same bird, on January 7 and January 8, 1937, near the same place on the open savanna near Tarara. After much asking, a native finally brought me a primary which had been incorporated in a headdress and which he assured me had been taken from one of these birds killed a long time ago. Comparing it with Australian specimens confirms the identification.

This Australian species has not been collected in New Guinea.

Ptilinopus regina Swainson

Daru: 1 ♂ ad., 1 (sex ?) imm.; June 9, 1936.

Wing: ♂ ad. 135.

This is an Australian species not yet recorded from the mainland of New Guinea though the present specimens, extending its range within two miles of the New Guinea coast, make it seem probable that it occurs there.

The specimens are very like Cape York birds.

Ptilinopus iozonus pseudohumeralis, new subspecies

TYPE.—No. 447416, Amer. Mus. Nat. Hist.; ♂ ad.; Palmer River, 2 miles below its junction with the Black River, altitude 100 meters, south New Guinea; July 10, 1936; Richard Archbold, A. L. Rand and G. H. H. Tate.

DIAGNOSIS.—This race differs from *humeralis* in the generally brighter, more yellowish-green color of the upper- and underparts, and the more pronounced grayish subterminal markings in the lateral tail-feathers seen from above. The apparently less pronounced gray area in the anterior part of the scapulars, the larger orange area on the abdomen and the greater amount of yellow in the abdomen may be due to differences in the make of the skins.

RANGE.—Only known from the upper Fly but possibly the birds from the southern slopes of the Snow Mountains will prove to be this form.

REMARKS.—D'Albertis collected several specimens of *P. humeralis* (=*P. iozonus*) on the upper Fly in 1874. This race is of course much more closely related to *humeralis* than to *iozonus* of the Aru Islands or *finschi* which is the form living on the middle and lower Fly, on the Wassi Kussa River, and all southeast New Guinea.

Geopelia striata papua, new subspecies

TYPE.—No. 421772, Amer. Mus. Nat. Hist.; ♂ ad.; Wuroi, Oriomo River, south New Guinea; January 19, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Differ from *placida* from the Northern Territory in the darker nape with the black edgings to the feathers more pronounced, in the generally darker upperparts, and in the barring of the sides and back of the neck being coarser, the black bars being wider.

WING MEASUREMENTS.—10 males from Penzara, Mabaduan, Daru, Wuroi, Dogwa: 101–106 (Aver. 103.2).

RANGE.—South New Guinea.

REMARKS.—The Australian members of this species need revision but none of these is darker than *placida* from the Northern Territory. The south New Guinea birds are the same size as Northern Territory birds. Cape York birds differ more from the south New Guinea birds in being smaller (wing: 6 ♂, 94–100, aver. 96.6).

The southeast New Guinea birds compare well with south New Guinea birds in size (wing: ♂, 100, 100, 102, 104) but in coloration are more similar to the North Australian birds and should be referred to *placida*. Birds from New South Wales and Victoria (*tranquilla*) are larger, six males have the wings as follows: 105, 105, 106, 107, 108, 108.

Trugon terrestris leucopareia Meyer

Fly River, 5 miles below Palmer Junction: 3 ♂ ad.; May 22–26. Wing: 179, 179, 181.

These compare well with three southeast New Guinea males from Kubuna and Milne Bay. This was a shy retiring bird of the forest floor, possibly more common than the number seen would indicate.

At Palmer Junction camp the natives brought in several; at the

Black River camp occasionally one or a pair of birds were seen but none secured there. Both on the ridges and in the damper forest of the little valleys the birds flushed within a few yards of me to go flying with whirring, grouse-like flight some distance through the forest before lighting on the ground.

About June 10 Tate found a nest of this species. It was near a well-used trail near camp and the nest had been deserted recently but the well-grown embryo taken from the egg made identification certain. On July 7, I found another nest similar in location and structure. This nest was on the ground at the base of a tree on a slight ridge covered with tall, not especially dense forest. The under-growth was light open-growth of slender, woody plants.

The nest was placed against a plank buttressed tree, in the angle between two buttresses so that the nest touched the trunk, one buttress and a stick resting against the other, thus protecting it from approach on three sides.

The nest was a rather substantial affair for a pigeon's, placed on the ground from which the bird had evidently cleared the moss. It was composed of two parts; the foundation, about 200 × 260 mm. across and several centimeters deep in places, of short dead sticks, some up to 20 mm. in diameter and many quite rotten; and the nest proper, composed almost entirely of rootlets with a few bits of moss and dead leaves. This was quite flat and measured about 130 mm. across by 10 mm. thick. Strangely enough this upper part of the nest was not placed in the center but at the back of the foundation platform. This, which I first thought was accidental, was true of all three nests seen, giving a little platform of sticks in front of the nest.

As I approached the nest the incubating bird flushed when I was fifteen feet away, rising sharply, then flying down at a long angle and lighting on the ground about 50 yards away. The bird did not return to the nest, which remained deserted until I collected the egg several days later.

The only other station for the species on the 1936–1937 Expedition was the Sturt Island camp. Here, on October 12, a boy showed me a nest similar in construction and location to the nest described above, and placed on the ground against a tree trunk between two buttresses, in the forest near the Fly River. The first time I visited this nest the bird flushed from the nest, rose sharply to ten or fifteen feet, then flew down at a long angle to light on the forest floor where I was unable to secure it. Two days later when I visited the nest it was deserted, and the next day the egg was broken. No other example of this species was seen during the month spent at this camp. Each of the three nests seen contained a single egg.

The egg collected June 12 was bluntly ovate in shape, the small end little smaller than the large end; the shell was slightly granular with a slight gloss; white in color. It measured 28.2 × 38.9 mm. The egg collected July 13 was similar and measured 27 × 39.5 mm.

Trichoglossus haematodus haematodus (Linnaeus)

Palmer River, 2 miles below its junction with the Black River: 3 ♂, 1 ♀; June 15–24.

Wing: ♂ 132, 136, 139; ♀ 130.

These birds differ from southeast New Guinea birds in the blacker, less orange-brown tinged nape, the blackish cheeks tinged with blue instead of browner tinged greenish, and the yellower neck band, and in these characters compare well with *haematodus*.

On two characters this series differs from typical *haematodus:* the paler and duller red of the breast and the black edgings of the breast feathers being mixed with green. As these characters are evidences of immaturity in this species, even though one of the present series does not appear immature otherwise, I think it inadvisable to separate them on this basis.

This considerably extends the range of this race, which thus ranges in south New Guinea from the Arfak Peninsula to and across the upper Fly River (for these specimens were taken on the east bank of the Palmer, tributary of the Fly).

In the eastern part of this range it is separated from the coast by the range of *nigrogularis* which ranges from Princess Marianne Straits (Bangs, O., and Peters, J. L., 1926, Bull. Mus. Comp. Zoöl., LXVII, p. 426) eastward to the Fly River which it crosses (one specimen from Gaima) and inland at least to Lake Daviumbu on the middle Fly from which locality we also have specimens.

Is it possible that the dark-bellied specimens from the southern slopes of the Snow Mountains which have been considered individual variations represent a coastal form? A single specimen from the Setekwa River which I have examined agrees with *haematodus* except for the black belly.

Charmosynopsis multistriata Rothschild

Fly River, 5 miles below Palmer Junction: 2 ♀ imm.; June 4, 1936.

Wing: ♀ imm. 94, 98.

O. Grant records that the sexes of this species are similar. The present two females, compared with two adult males from the upper Setekwa River, differ in the almost complete lack of yellowish in the sides and top of head, the duller yellow of the streakings below, the reduction in size of the orange-yellow spots in the hind neck, the grayer nape, the green back lacking an olive tinge, and the pointed tail-feathers. No immature specimens from the Snow Mountains are available to determine whether the color differences are geographical or are a matter of age.

This rare species was hitherto known only from the Mimika, Setekwa and Utakwa Rivers.

Opopsitta gulielmi-tertii fuscifrons (Salvadori)

Tarara: 1 ♂; December 30, 1936.
Penzara: 1 ♂; December 18, 1936.
Gaima: 3 ♂, 3 ♀; November 14, 1936.
Lake Daviumbu: 5 ♂, 2 ♀; August 20–September 18, 1936.
Palmer River, 2 miles below its junction with the Black River: 1 ♀; July 18, 1936.

The Black River specimen is abnormal in having part of its plumage yellow, but it has the typical brown forehead of this race. The other specimens are typical representatives of this form except the series from Gaima. Of the specimens from Gaima the two adult males have the forehead brown; a male in second-year plumage and a female in adult plumage have a slight bluish tinge to the forehead; of the two immature females one has the forehead somewhat bluish, the other has the forehead blue and the cheeks tinged bluish, comparing well with an immature male from Kubuma.

This indicates that while the race *fuscifrons* reaches the east bank of the Fly River from the coast to its headwaters, there is a tendency toward the eastern race *suavissima* on the east bank of the Fly River at its mouth at least, and this tendency appears in the immature plumage most strongly, is less evident in the second-year males and females, while the adult males are typical *fuscifrons.*

Aegotheles wallacei wallacei Gray

Fly River, 5 miles below Palmer Junction: ♂ adult; June 3, 1936.
Wing: 119.

This specimen had no external trace of a right leg. Whether or not it had ever had a right leg it certainly had successfully lived a long time without one, was in good plumage and flesh, and had somewhat enlarged testes.

This is the most easterly record of this species.

Aegotheles cristatus major Mayr and Rand

Tarara: 1 ♂, 1 ♀; January 11, 17, 1937.

Wing: ♂ 138; ♀ 142.

This race was founded on the unique type. These two new skins compare well with the type, except that the throat and upper breast are less heavily marked, in one of them as lightly marked as some North Queensland birds. The darker back, with more distinct barring and the coarser black fleckings in the white of the head also distinguishes the New Guinea specimens.

Birds from the Northern Territory average larger (12 males, average wing 135.8) than North Queensland birds (7 males and females, average wing 132.1) somewhat approaching the south New Guinea birds (138, 142, 149); but the New Guinea birds also differ from these in the darker upperparts with barring coarser and more distinct, the coarser black fleckings in the white of the top of the head and the narrower nuchal band. Many of the Northern Territory birds in the gray phase have the outer edges of the primaries more or less rufous or have a rufous tinge on the back or on the top of the head. This is lacking in the three New Guinea specimens.

The two south New Guinea birds were found in shrubby trees in the open savanna.

Lyncornis papuensis astrolabae (Ramsay)

East bank Fly River, opposite Sturt Island: 1 ♂, 1 ♀; October 23, 1936.

Wing: ♂ adult 192; ♀ adult 199.

These specimens compare well with three skins from Astrolabe Bay and both sets of specimens differ from three Arfak skins in being darker above, with larger black markings and in having the rufous markings paler.

Mayr (1937, Amer. Mus. Novitates, No. 939, p. 7) has pointed out these characters separating the Astrolabe Bay from Arfak birds. Lacking material to decide on the status of *Eurostopodus astrolabae* Ramsay, described from southeast New Guinea and which is obviously *Lyncornis papuensis*, he suggested *elegans* Reichenow, described from the Ramu River, as the name for the Astrolabe Bay birds. But since south New Guinea birds are similar to Astrolabe Bay birds it seems probable that all birds from east New Guinea are the same and *L. p. astrolabae* should be used for all of them with *elegans* Reichenow a synonym.

FIELD NOTES.—The only time I encountered this dark nightjar was at the Sturt Island Camp where I collected the above two birds and their nest.

NEST.—The egg was laid on the bare ground; and it looked as though the dead leaves that littered the ground had been scraped aside leaving an area of bare earth about 18 inches across, and the single egg was lying on the side of this. This was in a small opening in the low, rather dense slender undergrowth and bamboo of the open forest on a ridge near the tea-tree swamp.

The nest contained one egg. The egg was very bluntly ovate, the small end little smaller than the large end; ground color light brown but so heavily marked with intermingling blotches of light and dark brown, more or less obscured with white, as to give the egg a mottled appearance.

The egg measured 25 × 32 mm.

When I first approached the nest in the early morning the female flushed when I was 20 feet away and made several short flights, alighting on ground or low bamboo before I secured it. No male could be found then but I returned to the nest again that evening after dark and found the male incubating. Its eyes gleamed orange-red in the rays of the torch.

Both birds had stomachs filled with small green cicads only.

Syma torotoro pseutes Mathews

Gaima: 1 ♂, 3 ♀; November 11–21.

East bank Fly River, opposite Sturt Island: 3 ♂, 3 ♀; October 10–29.

Lake Daviumbu: 4 ♂, 2 ♀; August 21–September 24.

Fly River, 30 miles above D'Albertis Junction: 1 ♂; August 11.

Fly River, 5 miles below Palmer Junction: 1 ♂, 1 ♀; May 17, 31.

Palmer River, 2 miles below its Junction with the Black River: 1 ♂; June 29.

For measurements, see under *S. t. brevirostris.* When Mayr and I worked out the south New Guinea collection of the 1933–1934 Archbold Expedition we considered the Oriomo River (Wuroi and Dogwa) birds as *pseutes.* They were plainly distinct from *meeki* on the basis of their darker coloration below and from *torotoro* in their smaller size (1937, Bull. Amer. Mus., LXXIII, p. 80). Junge (1937, Nova Guinea, (N. S.) I, p. 174) has considered the birds from the southern Snow Mountains as *pseutes,* differing from *torotoro* in the average smaller size. Besides the material listed above I have three males from the upper Setekwa River and the Snow Mountains.

This material substantiates the conclusions that *pseutes* is a valid race, distinguished from *torotoro* by its small size and from *meeki* by its darker underparts. The birds from Gaima, near the mouth of the Fly, and those from the Oriomo River are slightly paler below than those from the upper Fly and the Snow Mountains but should all be included in this race. No female has as small a black area in the crown as do some *meeki,* but the black in the crown averages but little larger than in that race. The range of *pseutes* is apparently from the southern slopes of the Snow Mountains to the east bank of the Fly River, excluding the range of *brevirostris*. On both sides of the Fly River it extends to the coast. West of the Fly it reaches to the Oriomo River; a specimen from Mabaduan is intermediate between it and *brevirostris* which occurs on the Wassi Kussa River.

Syma torotoro brevirostris, new subspecies

TYPE.—No. 447419, Amer. Mus. Nat. Hist.; ♂ ad.; Tarara, Wassi Kussa River, south New Guinea; December 24, 1936; Richard Archbold, A. L. Rand and G. H. H. Tate.

DIAGNOSIS.—The shortness of the bill distinguishes this form from all the other races of *torotoro*, and the paler underparts and upperparts also distinguish it from all but *meeki*. Compared with *meeki* in color the underparts have about the same paleness, but the back is paler, the fresh green feathers being lighter and with less of an olive tinge; the worn bluish feathers being lighter blue.

	MALE		FEMALE	
	WING	BILL[1]	WING	BILL
brevirostris				
(Tarara)	71, 71, 71, 72, 72, 73, 76	27.5, 28.5, 28.5, 29, 29.5, 30	71, 73, 73, 73, 74	27, 28, 29, 29.5, 31
meeki				
(Milne Bay and vicinity of Yule Island)	71, 72, 73 74	29, 31, 31.5, 32, 32	72, 73, 74, 74, 76	30.5, 31, 31, 32, 32.5
pseutes				
(Fly River)	70, 72, 73, 73, 73, 73, 75, 76, 78	29, 30, 30, 30, 30, 30.5, 31, 31.5, 32, 32, 32, 33	72, 73, 73, 74, 74, 75, 76, 76	27.5, 28, 30, 30, 30, 30, 31, 31
(Oriomo River)	73, 73, 74, 74, 75, 76	30, 31, 31.5, 31.5, 32	71, 74	31, 31
tentelare				
(Aru Islands)	75, 77	31.5, 31.5	74, 74, 77, 77, 78	30.5, 31, 31.5, 33

DISTRIBUTION.—Known only from the area between the Wassi Kussa and Morehead rivers. Its range may extend farther west, but to the east *pseutes* replaces it on the Oriomo River.

REMARKS.—In this series a number of adult birds have a small dusky mark on the culmen near the tip, but this is evidently individual, and also occurs occasionally in *pseutes* and *meeki* in apparently fully adult birds, even in some cases in breeding individuals. The young, of course, has the bill black. In *flavirostris* from Cape York the black on the tip of the bill is more pronounced.

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[1] Bill measured with dividers from anterior edge of nostril to tip.

Sauromarptis tyro archboldi, new subspecies

TYPE.—No. 447418, Amer. Mus. Nat. Hist.; ♂ ad.; Tarara, Wassi Kussa River, south New Guinea; January 20, 1937; Richard Archbold, A. L. Rand, and G. H. H. Tate.

DIAGNOSIS.—Differs from *tyro* in the much paler underparts, with only a tinge of buffy in breast and belly, instead of being lightly or distinctly ochraceous; in the paler spotting in the crown, hind neck and fore back, and the paler blue of the wing coverts and rump.

COLOR OF SOFT PARTS.—Iris brown; maxilla black, mandible white; feet pale greenish gray.

WING MEASUREMENTS

	MALE	FEMALE
Aru Island	145, 150	147, 152, 153
South New Guinea	(8) 146–156 (average 150.7)	(13) 148–156 (average 152.6)

RANGE.—Known only from the area between the Morehead and the Wassi Kussa River in south New Guinea.

REMARKS.—This is the first authentic record of this Aru Island species for New Guinea. Salvadori (1881, Atti. R. Accad. Sci. Torino, XVI, p. 621) described what are evidently two specimens of this species as *S. cyanophrys*. The skins were said to have come from New Guinea. In comparing this new species, Salvadori says it is more rufescent below than *tyro*. Obviously the specimens were mislabelled Aru Island skins.

In both the Aru Island and New Guinea specimens there is considerable variation in the amount of black edgings of the feathers of the underparts. In all but one of the New Guinea specimens the markings are very few and narrow and chiefly on the breast; a few specimens are without them but one, possibly immature as the bill is mostly black, has the black scaling very conspicuous on the breast and fairly so on the upper abdomen and flanks. The same variation is shown by the Aru Island skins, but in these the heavily marked skins have the bill the same color as the rest of the series.

This kingfisher was a common species in the savanna at Tarara and Penzara; apparently it is as much a savanna species as *Dacelo leachi*, and was not seen in the forest. It was usually seen in pairs, or loose parties of three or four, sitting well up in the savanna trees, and was usually wary and difficult to secure. Their call is a loud, throaty "Kurk" repeated a number of times, somewhat similar to one of the calls of *D. leachi*. The birds sit upright and the tail is occasionally flicked up over the back for a few seconds, both when calling and when silent.

Six stomachs examined contained insects including beetles, ants, winged ants, and a five-inch walking-stick insect. Sometimes the birds descended to the ground for their prey; probably some are taken from leaves and bushes, and one I saw was fluttering about on the edge of a savanna tree apparently catching large winged green ants from the air and from the leaves; its stomach was crammed with these insects.

They sleep roosting in savanna trees as Tate shot one by torch light one night in such a situation. Six breeding females, including one nearly ready to lay, were taken in December and January, but strangely enough none of the males had fully enlarged gonads. The natives say that, unlike *Dacelo leachi*, which nests in holes in arboreal termite mounds, this species nests in holes in trees.

Clytoceyx rex rex Sharpe

Palmer River, 2 miles below its junction with the Black: 1 ♂ imm., 1 ♀ imm.; June 9, 25.

Altitude 100 meters.

Wing: ♂ imm. 163; ♀ imm. 162.

Though immature, the small size of these specimens definitely places them with the eastern race and this greatly extends its range westward.

Halcyon nigrocyanea stictolaema (Salvadori)

East bank Fly River opposite Sturt Island: 3 ♂; October 15–27.

Wing: ♂ ad. 93, 94, 94.

On the upperparts these three birds are very similar; on the underparts two of the males have the throat feathers white, tipped with blue, giving a mottled appearance, and the rest of the underparts blue and black. The other male has more white on the throat and a narrow white bar across the central portion of the lower breast.

Tanysiptera hydrocharis Gray

Tarara: 1 ♂ ad., 1 ♀ ad.; January 3.

Lake Daviumbu: 1 ♀ imm.; September 16.

Wing: ♂ ad. 92; ♀ ad. 86; ♀ imm. 83.

This is the third record for New Guinea for this Aru Island species (see 1937, Bull. Amer. Mus., LXXIII, p. 85, for other two south New Guinea records).

Tanysiptera sylvia mira Hartert

Fly River, 5 miles below Palmer junction: 1 ♂ ad., 1 ♀ ad.; May 28, June 4.

Lake Daviumbu: 1 ♂ imm.; September 5.

These two adults have the fully elongated central tail-feathers. Compared with the series of 3 birds from Hollandia and Ifaar (which all have some juvenile feathers and none has the very elongated central tail-feathers of the adult complete) from which Hartert described *mira*, they appear to be the same. Not only do they differ from *salvadorina* in the darker underparts and in the darker blue of the tail and tail-coverts as Hartert pointed out, but the wing-coverts and outer edges of the remiges are also darker blue.

This appears to give *mira* a discontinuous distribution, but immature specimens of this species which probably belong to this race have been recorded on the Eilanden and Setekwa rivers and as it is apparently everywhere a rare bird in New Guinea it will probably be found elsewhere in western New Guinea.

This form is however very close to *sylvia* of Cape York, the only constant difference is that the Cape York birds average considerably darker below, though the lightest colored specimens are very nearly as light as the New Guinea specimens.

WING MEASUREMENTS

	MALE	FEMALE
South New Guinea	101	93
Hollandia and Ifaar	98	96, 100
Cape York	94, 94, 96, 98, 99	94, 94, 95, 96, 67

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 20

ON SOME PASSERINE NEW GUINEA BIRDS

BY A. L. RAND

I have already reported on some of the non-passerine birds collected by the 1936 New Guinea Expedition in south New Guinea (1937, Amer. Mus. Novit., No. 990) and the present paper deals with the more interesting of the passerine birds studied.

Three new subspecies are described from south New Guinea and one from southeast New Guinea.

Pitta versicolor simillima Gould

Daru: 1 sex (?); June or July, 1936.

Wing: 120.

The only record for the New Guinea mainland is that of two specimens secured by D'Albertis on the Katau River in October and November. The present specimen compares well with a series from Cape York.

Campochaera sloetii flaviceps Salvadori

Palmer River, two miles below its junction with the Black River: 2 ♂ ad.; July 12, 18.

Fly River, 30 miles above D'Albertis Junction: 2 ♂ ad., 1 ♀ ad.; August 9.

Wing: ♂ ad. 104, 105, 107, 109; ♀ ad. 107.

These birds appear identical with birds from the southern slopes of the Snow Mountains at 2000 feet (Meek coll.) which have wing measurements of ♂ 104, 107, ♀ 103, 105. There are also in the American Museum collection a male and female from Mt. Victoria, 4000–5000 ft., April–June, 1896, and another male and female from "British New Guinea." Two of these specimens are slightly paler than the Fly River birds, one, an adult female, is about as dark; the fourth is a skin from a spirit specimen. Wing measurements are ♂ 104, 111, ♀ 102, 103. Claude Grant (1915, Ibis, Jub. Sup., No. 2, p. 121) recorded that it was a bird of the tree tops, gave a clear whistle, and had the habits of a flycatcher dashing out after passing insects and returning again to its perch.

I found this bird only on the upper Fly where it was fairly common. It was usually in small parties of three to six in number and kept in the tops of the tall trees. They usually stayed in the top of a tree for but a short time, calling and moving about, then flew some distance over the forest so that they were difficult to secure. Their calls were soft whistles, and melodious trills, frequently given while the birds were on the wing. The stomach contents of three birds consisted of fruits only.

Crateroscelis murina pallida, new subspecies

TYPE.—No. 426456, Amer. Mus. Nat. Hist.; ♂ ad.; east bank Fly River, opposite Sturt Island; October 30, 1936; Richard Archbold, A. L. Rand, and G. H. H. Tate.

DIAGNOSIS.—The male differs from that of *murina* in the olive-brown instead of black top of the head, the lighter, more brownish back, and the much whiter underparts with the paler rufous restricted to the sides and a narrow line across the breast. It resembles *capitalis* Stres. and Pal. in lacking the black of the top of the head, but is even paler, has the back lighter and more brownish, and the underparts whiter.

WING: ♂ ad. 59, 59, 62, 62; (sex ?) 59.

DISTRIBUTION.—Known only from the middle Fly (Lake Daviumbu and Sturt Island).

REMARKS.—Specimens from the upper Fly River (Palmer Junction and Black River Camp) are *murina;* though the underparts have more white than in most *murina* from the rest of New Guinea, the males have the top of the head black.

Gerygone fusca pallida Finsch

Daru: 1 ♂ ad.; March 9.

Wing, 60; tail, 43; bill, culmen from base, 13; exposed culmen, 9.5.

The present specimen is in breeding condition and in fairly fresh plumage.

This race has been known from only two immature specimens, both from western New Guinea (Lobo Bay and the Mimika River), and the present example provides an opportunity for discovering the characters of the adult of this race (assuming that birds from the Mimika River and from Daru are the same).

In Meise's grouping of the races in the formenkreis *Gerygone fusca* (1931, Nov. Zool, XXXVI, pp. 358–374) this specimen should be included in his *laevigaster* group which also includes *broomei*, *mastersi* and *laevigaster*. The white band on the under side of the base of the tail is only indicated by a pale area and the white of the forehead extending back on the sides as a line over the eye is well defined.

In the olive-brown color of the upperparts it is closest to *laevigaster* and agrees with it in the distribution of color of the tail but differs in being paler on the upperparts, in having the white on the forehead slightly wider, the underparts whiter and the larger wing and larger bill. From *mastersi* and *broomei* it differs in the browner upperparts, slightly wider white on the forehead, and the longer wing and larger bill.

Acrocephalus arundinaceus australis (Gould)

Lake Daviumbu: 10 ♂ ad., 1 ♀ (?) ad.; August 20–September 13.

Wing: ♂ ad. 67, 67, 67, 68, 68, 68, 69, 69, 70, 70.

The above series includes both very worn and freshly plumaged birds. In color the freshly plumaged birds average slightly darker on top of the head than East Australian specimens but are practically indistinguishable; the bill is about the same length. Birds from South Australia and New South Wales have a wing of 70–76, Queensland birds have an average slightly shorter wing 69–72, and the present New Guinea series average slightly shorter again 67–70. There is too much overlap to separate any of these populations. Hartert (1930, Nov. Zool., XXXVI, p. 88) was unable to separate two males (wing 69 and 73) taken at Anggi lakes, Arfak, from *australis*. The type of *cervinus* deVis is apparently unique. It came from southeast New Guinea and was said to have a wing of 80 mm.

At the inner end of the outlet from Lake Daviumbu, where the water was one to two fathoms deep, there were areas of lotus lilies, floating mats of rice grass and clumps of tall reeds rising ten feet and more above the water. Farther back from the lake were large impenetrable areas of these tall reeds. This was the chief habitat of this bird, in which it fed and nested, and here it was very common over a small area. I found also a few males singing in the clumps of bamboo near this part of the marsh; none was found elsewhere. Though the habitat of this species and of *Megalurus albo-limbatus* differs somewhat, both species were found only in this small area about the channel, and both were very common in it.

The males sang sitting up straight in the tops of the reeds but were very shy and at my approach dropped down into the reeds or flew some considerable distance over them. In the early morning their songs were heard everywhere. Apparently they fed low in the reeds.

On August 25, I collected a nest and saw two other similar nests which were probably of this species but were not positively identified.

The nest collected was placed about four feet above the water in the edge of a clump of reeds close by the open water of the channel. It was quite conspicuous and could be seen for some distance. It was placed among several upright reeds to the stems of which it was attached, by having strands carried around the stems and worked back into the nest. The nest was a deep, firm, rather tidy, cup-shaped structure composed largely of fine dead grasses and grass heads lacking the seeds, with many small bits of animal silk throughout, and with a considerable amount of rootlets from bases of reeds in the upper portion of the nest. This gave greater firmness to the rim and the portions carried around the reed stems for attachments. It was lined with fine dead grasses, some of them with the threshed-out seed heads attached. It measured: outside, 95 mm. deep × 90 mm. wide; inside, 55 mm. deep × 50 mm. across.

The nest contained two eggs. The two eggs are ovate in shape, shell smooth with a medium gloss, ground color whitish tinged bluish gray, irregularly marked with dots and flecks, and sparsely with spots and blotches of dark chocolate brown and much paler olive-brown, and secondary grays. One egg has more and larger blotches of pale brown, which color is perhaps caused by a dilution due to a thinner layer of the chocolate-brown pigment. In one egg the larger spots tend to form a wreath on the larger end; in the other they are more scattered. The eggs measure 20.8 × 14.3 and 20.3 × 14.3.

The adult was very shy at this nest. After a long wait I saw it come to the nest through the reeds and start to brood, but when I attempted to collect it, it slipped away through the reeds again. And when I finally secured it I was not sure it was the bird which had left the nest as there were several of this species in the same small clumps of reeds. Another similar nest, undoubtedly of this species, was less than twenty yards away. One male, with enlarged testes had the left testis slightly larger than the right.

Megalurus timoriensis muscalis, new subspecies

TYPE.—No. 426547, Amer. Mus. Nat. Hist., ♂ ad.; Lake Daviumbu, middle Fly; south New Guinea; September 9, 1936; Richard Archbold, A. L. Rand, and G. H. H. Tate.

DIAGNOSIS.—Very different from the other New Guinea races in its smaller size, duller less rufescent coloration, and the pronounced streaking in the crown; closest to the Australian bird but differs in the duller color of the crown with wider and more plentiful black streaks in it, in the more extensive black streakings of the back and these streaks being wider, and with paler edgings to them, in the heavier streaking of the upper tail-coverts, in the slightly paler underparts, and in the larger bill.

Measurements of Males

	Wing	Bill
Lake Daviumbu	62,63,63,63,64,66,67	16,16,16,16.5,16.5,16.5,16.5
Queensland	63,63,66,66	14,15,15,16
Northern Territory	61,63,65,66	14.5,15,15.5,16
Northwest Australia	61,63,65,66	14.5,15,15.5,16

Distribution.—Known only from the grasslands of the middle Fly River.

Remarks.—This was a resident, breeding population. Compared with these specimens the type of *melvillensis* is darker and more rufescent above, with the streaking in the crown obscure and the streaking of the back reduced.

This form was only found at Lake Daviumbu where it was fairly common in the dense grass of the *Banksia* savanna ridges. It was very shy and retiring. Sometimes a bird flushed, flew a short distance and dropped back into the grass. It did not perch on the tops of the grass but always sought secure shelter where I was unable to flush it again, though I could hear its little rattling scolding call.

Later the natives staged a wallaby drive and burned the grass from these ridges. This did not drive the warblers into the adjacent swamps as I expected, but concentrated them in the little patches and fringes of grass missed by the burning. They were conspicuous here, and perhaps confused, perching up in plain sight on the grass and in the trees but were wary, often flying before I could approach within gunshot. They were frequently in pairs and breeding, as the gonads of five September specimens indicated. On September 8, I saw one give a flight song, rising thirty feet above the ground, give its short song, then sink back into the grass. In flight the tail is carried more or less horizontal while the body is carried somewhat upright, giving a distinctive bend in the outline of the bird.

Megalurus albo-limbatus (D'Albertis and Salvadori)

Lake Daviumbu: 6 ♂ ad., 4 ♀ ad.; August 20–September 20.

	Male	Female
Wing	57,58,58,60,60,62	54,55,56,56
Tail	60,57,60,60,62,57	55,56,55,56
Culmen from base	17,17.5,18,18,18.5,17.5	17,15,17,17
Tarsus	23,22,24,23,23,23	—,20,20,21

The present series agrees well with the original description and Sharpe (1883, Cat. Birds Brit. Mus., VII, p. 129) has given a more detailed description. In freshly plumaged specimens however the white edgings all around the inner secondaries, which have given the species its name, are not pure white on their outer margins but strongly tinged buffy, the whiteness of most specimens being the result of wear and fading. In general color pattern this species is very similar to *timoriensis* but differs in the more slender and longer bill, the much shorter tail about equal to the wing in length, and the tail-feathers being broadly rounded at the tip. *M. gramineus* of Australia has the tail nearly as short proportionately, but the tail-feathers are more pointed, though not as much so as in *timoriensis;* it has streakings on the throat pronounced and has a much more slender, shorter, straighter bill.

This species has hitherto been known only from the three specimens collected by D'Albertis 430 miles up the Fly River, August 23–25, 1877.

On the inner end of the channel from the Fly River to Lake Daviumbu, where the clumps of reeds and masses of floating rice grass on the edge of the lake grew in from one to two fathoms of water and the area had to be explored by boat, I found this marsh warbler common. The ten specimens collected and the two nests found were all within two or three hundred yards of each other. Though common in this little area I saw it nowhere else in the extensive marshes explored. Evidently it needs a very special type of habitat. *Megalurus timoriensis* was not found in this habitat, being found only on the savanna ridges. This was a secretive bird, keeping low in the vegetation where it crept about, only occasionally venturing out into the more open stands of reeds or lotus lilies unless forced from a dense clump of grass by my approach. And yet, though liking dense cover, sometimes it was not shy, and when I was pushing the boat through a clump of reeds one or two of these occasionally came up within a few feet of the boat inquisitively inspecting me and giving their little chattering call. Their habit of keeping to the shelter of the vegetation made them difficult to secure, but they frequently gave a little rattling scolding call and when startled into flight these birds usually flew but a short distance and then perched on the top of some clump of vegetation where they could be seen.

The two nests found in August and September were both very similar globular structures with an opening on the side near the top. One nest collected was composed outside of very coarse, dead, dry grass blades and a few grass stems, and scantily lined with fine, threshed-out, grass heads that do not cover all the flat grass blades of the body of the nest. The entrance was untidy and irregular with projecting ends of grass blades and the grass heads of the lining. The entrance appeared smaller than the size of the bird and in entering and leaving the loose projecting ends must be pushed aside by the bird. The nest measured outside about 130 × 180 mm. long, inside about 60 × 70 mm. high. The bottom of the nest was about 40 mm. thick. One nest was in a small patch of low floating rice grass with a few small reeds in it. This was in a mixed area of clumps of reeds, patches of rice grass, open stands of lotus lilies, and not far from open water. The nest itself was about two feet above the water, supported on all sides by dense grasses and woven about some of the stems. The vegetation so densely surrounded the nest as to effectually conceal it. Another similar nest was in a little islet of broad-bladed sedges ten feet across and twenty yards out in the lake from the edge of the marsh.

The first nest, collected August 25 contained 3 eggs; the second nest was ready for eggs on September 13. The eggs are broadly ovate in shape, the shell smooth with a medium gloss, ground color pinkish white, very heavily marked with small marks and specks of pinkish brown, many of the markings more or less over-laid with white to give secondary grays. These markings nearly obscure the ground color on the larger end of the egg and are heavily distributed over the rest of it.

They measure: 18.9 × 14.2; 19 × 14.1; 19.5 × 14.4.

The nests were found by seeing the adult fly from them when the boat was within a few yards of the nest. The adults were very shy about the nest and I had to wait a long time for them to return.

Malurus alboscapulatus dogwa Mayr and Rand

Tarara and Penzara: 5 ♂ ad., 1 ♂ imm., 3 ♀ ad., 1 (sex?); December 7–January 20, 1937.

Mabaduan: 2 ♂ ad.; April.

Gaima: 2 ♂ ad., 1 ♀ ad.; November 11–20.

Lake Daviumbu: 6 ♂ ad., 5 ♂ imm., 8 ♀ ad.; August 19–September 30.

Wing: ♂ ad. 43–47; ♀ ad. 42–46.

This well-marked race was hitherto known only from Dogwa and Wuroi on the Oriomo River. The present records extend its range from just east of the Morehead River, eastward to the east bank of the Fly River at its mouth, and inland to the grass country of the middle Fly River.

Microeca flavovirescens flavovirescens Gray

Tarara: 2 ♂ ad., 1 ♂ imm., 1 ♀ ad.; December 27, 1936, January 4, 1937.

East bank Fly River opposite Sturt Island: 1 ♂ ad., 1 ♂ (?); October 12, 15.

Lake Daviumbu: 1 ♀ ad.; September 13.

Fly River, 30 miles above D'Albertis Junction: 1 ♂ ad.; August 10.

Fly River 5 miles below Palmer Junction: 1 ♀ ad.; June 3.

Wing: ♂ ad. 77, 77, 78, 80; ♀ ad. 71, 73, 73.

This series differs from specimens from the Setekwa River, Kubuna, and the rest of New Guinea in the less deep yellow underparts, the sides of the breast and abdomen being more grayish green, with the paler yellow more restricted to the middle of the breast and belly, more whitish throat, and the duller, more grayish-green upperparts. Two males from the Aru Islands, typical *flavovirescens*, agree well with the south New Guinea birds.

DeVis, 1897, Ibis, p. 384, described *Zosterops cuicui* from Boirave, southeast New Guinea. This description appears to refer to this species, and the name *cuicui* must be used for the brighter yellow bird inhabiting most of New Guinea.

Monarcha trivirgatus subspecies?

Lake Daviumbu: 1 ♂ imm.; September 17.

Tarara: 1 ♂ (?) imm., 1 ♀ imm.; December 11.

Wing: ♂ imm. 74; ♂ (?) imm. 72; ♀ imm. 70.

This is the first record of this species for the mainland of New Guinea.

The three immature specimens have the upperpart darker slaty and the breast and flanks rufous, more richly colored than in six immature specimens of Cape York (*M. t. albiventris* Gould). For a discussion of the two Australian races see 1931 Emu, XXXI, pp. 1–5. Compared with four immature specimens of *gouldi* Gray from farther south on the Cape York peninsula the New Guinea birds are very similar, differing only in the slightly darker upperparts. It is advisable to wait for adult New Guinea material before attempting to separate them.

Rhipidura rufidorsa rufidorsa Meyer

Fly River, 30 miles above D'Albertis Junction: 1 ♂ ad.; August 9.

Fly River, 5 miles below Palmer Junction: 2 ♂, 1 ♀; May 15, 25.

Palmer River, 2 miles below its junction with Black River: 3 ♂, 3 ♀, 1 (sex ?); June 7, July 8.

Wing: ♂ 65, 65, 65, 66, 66, 68; ♀ 60, 61, 62, 65.

This species ranges over the whole of New Guinea. In addition to the range given by Hartert et al. (1936, Mitt. Zool. Mus. Berlin, XXI, p. 181, abb. 2) it also occurs in the Fly River area and in the Hall Sound area of southeast New Guinea (see beyond).

Hartert (1930, Nov. Zool., XXXVI, p. 76) was unable to decide on the subspecific status of the various populations of this species, but with the present material available it appears that three races must be recognized, based chiefly on the differences in coloration of the back. They are:

kumusi Mathews. Known only from the Kumusi River, the type locality. Six specimens from the type locality are more brightly rufous on the back than any other New Guinea populations and must be considered as a distinct race representing one extreme in coloration of the species.

I have no material from north New Guinea.

rufidorsa Meyer. This race, as the present material shows, includes the Jobi, Misol, Berau Peninsula, Weyland Mts., southern Snow Mts. and upper Fly River populations. These populations are not all exactly like one another, but they are intermediate between the bright rufous *kumusi* and the very different, pale, dull, southeast New Guinea birds and most of the populations are quite distinct from either of them.

The Misol (4 specimens) and Jobi (7 specimens) birds are considerably darker, duller rufous than *kumusi;* Weyland Mts. (3 skins) birds, a series from the southern slopes of the Snow Mts. and the Setekwa River (*nova* of Mathews) are slightly darker than Jobi skins, and the Fly River series are slightly duller again. The birds from the Arfak Peninsula, however, are slightly brighter rufous than any other population I have included in *rufidorsa,* even approaching *kumusi* from which it may be distinguished by being slightly darker.

The pale rufous bird from the south coast of southeast New Guinea appears to be without a name and I describe it as follows.

Rhipidura rufidorsa kubuna, new subspecies

TYPE.—No. 420457, Amer. Mus. Nat. Hist.; ♂ ad.; Kubuna, Central Division, Territory of Papua; December 3, 1933; Richard Archbold and A. L. Rand.

DIAGNOSIS.—The upperparts are dull and pale, much duller than *kumusi* and much paler than *rufidorsa;* the fore back tinged grayish and the rump and lower back paler.

MEASUREMENTS.—Wing: ♂ 64, 65, 66; ♀ 57, 60, 61.

DISTRIBUTION.—Probably the south coast of southeast New Guinea; specimens from Mafulu, 500 meters altitude, Kubuna, and Veimauri.

REMARKS.—A single specimen from Collingwood Bay is intermediate between this form and the bright rufous *kumusi*.

In this species the extremes in color between the subspecies occur in southeast New Guinea on opposite sides of the island. They intergrade through a comparatively short distance around the eastern end of the island, while intermediate populations (included in *rufidorsa*) occupy much larger areas around the western part of the island.

Rhipidura hyperythra mülleri Meyer

Tarara, Wassi Kussa River: 2 ♂; January 4, 18, 1937.

Fly River, 30 miles above D'Albertis Junction: 1 ♂; 1(sex ?); August 12, 1936.

Wing: ♂, 74, 77, 80.

This species is thus represented on both the upper and lower Fly River by the western race. The white in the outer web of the outer tail-feathers, measured along the shaft, is 9 and 10 mm. in extent in one upper Fly and one Wassi Kussa specimen.

Myiolestes megarhynchus wuroi Mayr and Rand

Tarara and Penzara: 3 ♂ ad, 1 ♂ imm., 5 ♀ ad.; December 16–January 18.

Mabaduan: 2 ♂ ad.; April 23, 24.

Wing: ♂ ad. 92, 93, 95, 95, 98; ♀ ad. 87, 88, 88, 92.

This extends the range of this race westward to near the Morehead River.

Myiolestes megarhynchus palmeri, new subspecies

TYPE.—No. 427259, Amer. Mus. Nat. Hist.; ♂ ad.; Palmer River, two miles below its junction with Black River, south New Guinea; July 18, 1936; Richard Archbold, A. L. Rand, and G. H. H. Tate.

DIAGNOSIS.—In the color of the underparts similar to *wuroi* but differs in being slightly more richly colored with the streaking of throat and upper breast averaging heavier and more distinct, giving an almost mottled effect in some specimens; and the upperparts being considerably darker and more olive. Compared with *despectus* it differs in the darker, more richly colored underparts, the darker and more brownish upperparts. Birds from the southern Snow Mountains, Weyland Mountains, and Wandammen Peninsula (*ferrugineus*) are more richly colored below and, while not so dark above, are much more brownish.

WING MEASUREMENTS: 6 males from type locality: 93, 95, 95, 96, 99, 100.

DISTRIBUTION.—Known from the Fly River area from its headwaters, on the west bank to Lake Daviumbu, on the east bank to its mouth (Gaima).

REMARKS.—There is some variation in specimens from one locality and an occasional specimen is much browner or much greener above than the others. The underparts also vary somewhat; one of the four skins from above D'Albertis Junction has very little streaking on the throat.

The specimens from Lake Daviumbu and Sturt Island camp are somewhat paler below than the upper Fly River birds; one of the Sturt Island specimens approaches *despectus* in the greenness of its back, but is slightly darker above and richer colored below. The single adult male from Gaima is as pale as *wuroi* below; but the darkness of the olive-colored back places it with this form.

Pitohui incertus van Oort

Fly River, 30 miles above D'Albertis Junction: 1 ♂ ad.; August 12.

Fly River, 5 miles below Palmer Junction: 2 ♂ ad., 1 ♀ ad; May 26–June 6.

Wing: ♂ ad. 115, 117, 118; ♀ ad. 109.

This species has hitherto been known only from the four specimens collected by Lorentz on the Noord River in 1907. (1909, Nov. Guinea, IX, p. 94.) The present specimens compare well with van Oort's description. In general appearance, in the shape of the bill, and in the stiffened feathers of the forehead this species is more nearly related to *Pitohui ferrugineus* than the other members of the genus. The male collected August 12 had enlarged testes. The stomachs of three of the birds contained insects.

Pitohui kirhocephalus brunneiceps (D'Albertis and Salvadori)

East bank Fly River, opposite Sturt Island: 1 ♂ ad.; October 7.

Fly River, 5 miles below Palmer Junction: 7 ♂ ad., 4 ♀ ad.; May 17–June 2.

Palmer River, 2 miles below Black River Junction: 4 ♂ ad., 2 ♀ ad.; June 8–July 26.

Wing: ♂ ad. (13) 116–128 (av. 121.4); ♀ ad. 117–122.

This series, from the type locality of *brunneiceps*, is very uniform, with the top of the head brown and the brown feathers of the throat more or less tipped with the fulvous color of the breast in both the male and female. In working out the collections of the 1933 New Guinea Expedition (1937, Bull. Amer. Mus., LXXIII, p. 181) Mayr and I had no material to compare with the southeast New Guinea birds and from a survey of the literature considered *meridionalis* Sharpe and *phaeocephalus* Reichenow as synonyms of *brunneiceps*. Now with additional material it is evident that this is incorrect. Two specimens labeled as males from Deva Deva have the top and sides of the head black and the throat black with the feathers tipped with the rufous color of the breast.

Four males from Chads Bay differ from the two Deva Deva birds in having the throat more extensively black, without any rufous tips to the feathers, and in the lighter, more brighter colored chestnut upperparts. A male from Mt. Cameron is similar to the Chads Bay specimens but is slightly darker on the back though not as much so as the Deva Deva birds. Mt. Cameron in the Owen Stanley Range is only a short distance from Deva Deva, so it is unlikely that the differences between these southeast New Guinea birds are geographical. A Milne Bay ♂ (= ♀ ?) is similar to *brunneiceps* but differs in the much lighter brown head, paler upperparts and underparts.

P. k. meridionalis (Sharpe) must be retained for the birds from opposite Yule Island eastward to East Cape and westward on the north coast a short distance to Chads Bay (Awaiama Bay).

Reichenow described *Rhectes phaeocephalus* from a single male from the Bailalla River. This specimen had a brown head. It was not compared with anything else so it is impossible to say whether it differs from *brunneiceps*, or from the female of *meridionalis*. Paludan (1935, Ornith. Monatsber., XLIII, p. 122) has recorded a specimen from the Gulf of Papua as *brunneiceps* but does not say whether or not he compared it with Fly River specimens.

Aplonis mystacea (O.-Grant)

Fly River, 5 miles below Palmer Junction: 1 ♀ ad., 1 ♂ imm.; May 23.

Fly River, 2 miles below Black River Junction: 1 ♂ ad.; July 26.

Fly River, 30 miles above D'Albertis Junction: 1 ♂ ad., 1 ♂ imm.; August 8, 11.

Wing: ♂ ad. 103; ♂ imm. 97, 98; ♀ ad. 100, 103.

This species has been collected only twice before: three females on the Mimika River in 1910 (1915, Ibis, Jub. Sup. No. 2, p. 41) and seven males and a female on the Wanggar River in 1931 (1935, Mitt. Zool. Mus. Berlin, XXI, p. 190).

Compared with the series from the Wanggar River the present specimens have the culmen slightly less arched when viewed from the side.

Oriolus flavocinctus mülleri (Bonaparte)

Bugi, 3 miles east of mouth of Mai Kussa River: 1 ♀; January, 1937.

This specimen probably belongs to this race which hitherto has been taken in New Guinea only on the Princess Marianne Straits (type locality).

Lichmera indistincta ocularis (Gould)

Lake Daviumbu: 20 ♂, 1 ♀; August 22–September 30.

Wing: ♂ ad. 66–72; ♀ 61.

This is the second record for New Guinea of this species. Stresemann and Paludan, who recorded several specimens from Merauke (1935, Mitt. Zool. Mus. Berlin, XX, p. 460), noted that they were darker than *indistincta* from northern Australia but, lacking comparative material, suggested the New Guinea birds might be referred to the dark Aru Island form *nupta*. The present series is not as dark as a series of *nupta* but compares fairly well with a series from Melville Island and New South Wales. The latter series may average slightly darker with duller green edges to the remiges, and with a slightly browner tinge in the back. The brownish tinge on the upperparts may be the result of foxing and the other characters are too slight to use in separating these two populations. Stresemann has shown that Melville Island birds are indistinguishable from New South Wales specimens (1912, Nov. Zool., XIX, p. 344).

Entomyzon cyanotis harterti Robinson and Laverock

Tarara: 3 ♂ ad., 1 ♂ imm., 4 ♀ ad.; December 7–January 19.

Penzara: 1 ♂ imm.; December 19.

Bangs and Peters have already recorded that Merauke specimens are similar to Cooktown specimens (1926, Bull. Mus. Comp. Zoöl., LXVII, p. 432). The Australian specimens available for comparison are slightly brownish on the throat and in the remiges and in the wing-coverts on the bend of the wing, probably due to "foxing"; but, allowing for this, the present series agrees rather well in color with North Queensland specimens except for the slightly darker fulvous on the inner edges of the remiges.

In size the south New Guinea birds are larger than Cape York birds, but birds from farther south, on the Barron River near Cairns, are as large and about the same in coloration.

The type of *connectens* Mathews from Inkermann should be included with the larger, darker form from New South Wales and Victoria.

WING MEASUREMENTS

harterti	MALE	FEMALE
South New Guinea	144, 151, 155	143, 148, 149, 152
Cape York	138, 139	136, 141, 144, 146
Cooktown	136	137, 140, 141
Barron River	155	150

cyanotis	Male	Female
Inkermann	156 (type of *connectens*)	
Dawson River	151	
New South Wales and Victoria	155, 156, 160, 166	152, 157, 158, 165, 166, 166

Xanthotis chrysotis giulianettii Mayr

Fly River, 30 miles above D'Albertis Junction: 1 ♂, 1 ♀; August 11–12.

Fly River, 5 miles below Palmer Junction: 4 ♂, 3 ♀; May 18–26.

Palmer River, 2 miles below Black River Junction: 5 ♂, 4 ♀; June 12–July 16.

Wing: ♂ ad. (9) 101–108 (average 103.7).

This series agrees well with a series from Baroka, Kubuna, and Mafulu in southeast New Guinea.

Xanthotis chrysotis saturatior (Rothschild and Hartert)

Tarara: 8 ♂, 6 ♀; December 7–January 5, 1937.

Mabaduan: 2 ♂; April.

Daru: 1 ♂; April 2.

Gaima: 4 ♂, 7 ♀; November 10–22.

Fly River, east bank opposite Sturt Island: 14 ♂, 5 ♀; October 7–November 1.

Lake Daviumbu: 10 ♂, 4 ♀; August 21–September 27.

Wing: ♂ ad. (10) 100–106 (average 102.7).

The birds from the middle Fly River show a tendency toward *giulianettii* which occurs on the upper Fly. The range of this race includes the Aru Islands, south New Guinea from the east banks of the lower and middle Fly River and west to include the southern slopes of the Snow Mountains. *X. c. rubiensis* replaces it in the Weyland Mountains (Hartert et al., 1936, Mitt. Zool. Mus. Berlin, XXI, p. 198). Comparing a series from the Weyland Mountains with the present material the former are quite distinct in the slightly brighter coloration below, and the darker upperparts, especially the crown.

Dicaeum geelvinkianum rubrigulare D'Albertis and Salvadori

Gaima: 4 ♂ ad., 2 ♀ ad.; November 13–22.

Lake Daviumbu: 1 ♂ ad.; September 16.

Fly River, 5 miles below Palmer Junction: 2 ♂ ad., 1 ♀ ad.; May 21–30.

Wing: ♂ ad. 50, 50, 52, 52, 52, 53, 53; ♀ ad. 47, 48, 49.

Compared with *rubrocoronatum* the males have the red of the upper breast much more extensive, and extending up onto the throat; the chin is whitish in all the males, but the size of this white area varies. It is least in the Lake Daviumbu bird and one from Palmer Junction. The rest of the underparts of this race are darker and the red of the crown is lighter.

This form was described (1879, Ann. Mus. Civ. Gen., XIV, p. 74) as characterized by the great extent of the red on the throat and the white chin. The type locality was 420 miles up the Fly River. Our specimens come from both above (Palmer Junction) and below (Lake Daviumbu) the type locality.

Dicaeum geelvinkianum albopunctatum D'Albertis and Salvadori

Daru: 2 ♂ ad., 1 ♀ ad.; March 20–April 11.
Tarara: 1 ♂ ad.; December 20.
Penzara: 1 ♂ ad., 2 ♀ ad.; December 18–19.
Wing: ♂ ad. 53, 54, 54, 55; ♀ ad. 49, 50, 51.

A series from Daru and the Oriomo River collected by the 1933–1934 New Guinea Expedition give wing measurements of ♂ ad (19) 51–56 (average 53.4), ♀ ad. 51.

In working up the collection of the 1933–1934 Expedition Mayr and I considered the Daru and Oriomo River birds as *rubrigulare* (1937, Bull. Amer. Mus., LXXIII, p. 236). We assumed the birds from the upper Fly River to be the same. The present collection however shows that there are two races in this area. Birds from Daru, the Oriomo River, and west of the Wassi Kussa River differ from *rubrigulare* in the greater extent of the red of the upper breast and throat, which covers the chin. In a few specimens white feathers are mixed with the red feathers of the chin but most of these are just moulting into the red breast. This race also differs from *rubrigulare* in the paler abdomen, the slightly lighter red of the crown, and the slightly larger size. Although *albopunctatum* (known only from the type from the Katau River) was based on an apparently albinistic specimen, the type locality is within the range of this form and the name must be used.

Stresemann and Paludan (1935, Mitt. Zool. Mus. Berlin, XX, p. 462) recorded an immature male or a female from west of the upper Merauke River as *rubrocoronatum*. Probably it belongs to this form or the preceding. The very different *diversum* has been recorded from the Noord River (1914, Nova Guinea, IX, p. 98).

Lonchura leucosticta (D'Albertis and Salvadori)

Tarara: 1 ♂ ad., 2 ♀ ad.; December 10, 20.

Lake Daviumbu: 3 ♂ ad., 1 ♂ ? ad., 2 ♀ ad.; September 2–24.

Wing: ♂ ad. 49, 49, 50, 50; ♀ ad. 49, 50, 51.

The female differs from the male in being duller colored below, in having the breast slightly more spotted, and the brown of the back duller.

As Salvadori has pointed out this species is probably most closely related to *tristissima*. Since both species have a streaked and spotted plumage I at first wondered if *tristissima* could be a melanistic representative of *leucosticta*, but this is not the case. The bill is not very different, and the feet of both are slender, though the toes are longer in *leucosticta*. The tail and tail-coverts are similar in the two species, the longer upper tail-coverts being black and the central tail-feathers black and rounded at the tip, not pointed and fringed with yellow as in many other forms. In color pattern both birds are streaked on the head but there are important differences in pattern. In *tristissima* when there is a paling of the breast it indicates a pale breast band while in *leucosticta* the chin, and upper throat are paler, and in *tristissima* the light markings in the wing-coverts tend to form wing-bars, quite different from *leucosticta*. D'Albertis collected the type of this species 300 miles up the Fly in 1875 (1881, Ornith. Pap. Mol., II, p. 437). The next specimen, an immature male, was taken in 1934 near the Oriomo River by our 1933 Expedition (1937, Bull. Amer. Mus., LXXIII, p. 246). It was shot by a boy who said it was one of a large flock on the savanna.

On the 1936 Expedition, I was able to get the small series listed above and the following are my encounters with it.

TARARA

December 10.—A shooting boy brought in two which he said he had found in dry savanna near the forest edge.

December 20.—Brass found a party of six in the bamboos of a narrow, light line of shrubbery along a dry watercourse through the savanna.

LAKE DAVIUMBU

September 2.—Where an arm of an extensive swamp extended in between two forested ridges there was a stand of tall, scattered tea trees and tall, dense cane grass (the latter about twelve feet high) growing in the water. A party of six to eight of these birds appeared, perching on the stems of the cane grass and I was able to secure one before they disappeared.

September 4.—I had returned to camp when Brass sent me a note that he had located a flock of weaver birds. I went at once to investigate and found him watching a party of eight to ten of these birds feeding on the seeds of a clump of bamboos on a forested ridge, about eighty yards from where the forest edge gave way to marsh. One was shot and the rest disappeared through the forest. Earlier in the day Brass had found two of this species in the grass fringe between the forest edge and a swampy lagoon, securing one of them.

September 24.—Rowing up the main part of the lake I found a flock of six or eight of this species and four or five of *Lonchura nevermanni* feeding in the half submerged low grass fringe of a garden island. The grass fringe was about ten yards wide, and on the island behind it was second growth and bamboo. I shot one of these weaver birds and the flock flew into the shrubbery, then down to the lake shore fifty yards, into the grass where I secured two more before the flock disappeared over the island.

Apparently this species favors the forest edges more than most other members of the genus. Several stomachs contained grass seeds; a female collected December 10 at Tarara was breeding.

Lonchura stygia Stresemann

Lake Daviumbu: 24 ♂ ad., 1 ♂ imm., 7 ♀ ad., 4 ♀ imm.; August 20–September 26.

Wing: ♂ ad. (10) 50–55 (average 52.3); ♂ imm. 52; ♀ ad. (7) 50–54 (average 51.8); ♀ imm. 52, 52, 53, 53.

Worn specimens become brownish, but females are more brownish above and have slightly duller yellow upper tail-coverts than males in similar plumage. All the immature specimens have at least a few black feathers of the adult plumage coming in but one immature female with only a half dozen black feathers in the plumage allows the fresh immature plumage to be described. The upperparts are dark grayish brown slightly tinged olive, the sub-terminal portion of the feathers of the crown blacker giving a slightly spotted appearance; rump and upper tail-coverts tinged with rust; tail-feathers blackish, the central ones edged with pale yellow and much more rounded at the tip than in the adult; upper wing-coverts fuscous lightly edged with olive-gray; remiges brownish black, the outer edges with grayish margins, the inner edges margined with ochraceous, under wing-coverts ochraceous. The underparts are buffy gray, grayer on the chin, breast obscurely spotted with dusky; auriculars blackish brown with whitish shaft streaks, under tail-coverts mottled buffy white and black. The worn immature plumage is much paler.

This black weaver bird was discovered in the Mandum swamp near Merauke in 1933 by Dr. Nevermann who collected two males (Stresemann, 1934, O. M. B., XLII, p. 102). It was next found by Archbold's 1936 Expedition on Lake Daviumbu, where it was common.

While perhaps more characteristic of the reeds and floating mats of rice grass of the marshes, it also was fairly common in the tall grass of the savanna where the fruiting grasses offered food. It was a sociable bird usually found in small flocks containing up to fifteen or twenty in number, and these sometimes mixed with feeding parties of *Lonchura nevermanni* and *Neochmia.* Once I saw a flock of twelve roosting on an isolated savanna tree on a ridge near the marsh where many swallows (*Petrochiledon*) were also roosting. It was typically lonchura-like in habits, feeding on the grass seeds in flocks; when alarmed the flocks kept together as they flew.

Of thirty-one adults collected in August and September three were in breeding condition. In September three nests were found. Probably the breeding season is prolonged and August and September are not in the height of the breeding season.

It is interesting to note that two breeding birds, one a laying female, were taken from a feeding flock of five birds, and only one or a pair of birds was seen in the vicinity of each nest. Apparently the birds retire from the flocks only for actual nest duties and join flocks some distance away for feeding, even when nesting is under way. The three nests were all in very similar situations, in the two or three foot high grass on little floating islets of grass on the edge of lagoons where they changed to marsh. These little islets were so loosely attached to the bottom that they could be turned by hand, and they were not solid enough for me to walk on them.

The nest found on September 19 was a lop-sided flask-shaped structure lying on its side, the top of the nest being straight, the lower edge curving up to the somewhat contracted "neck." It was simply supported by the dense grass amongst which it was built. It was a rather solid structure; the outside and body of the nest composed largely of dry, flat grass blades, and lined throughout, including the neck, with the dry heads of fruiting grass from which the seeds had been removed.

It measured outside 200 mm. long by 130 mm. deep by 110 mm. wide and the neck about 80 mm. across. Inside the nest chamber was about 80 × 80 mm. across, and the entrance 40 mm. across. The walls were from 20–30 mm. in thickness.

The other nests collected on September 12 and September 28 were similar in material, construction, and location, but one was more untidy and differently proportioned, being outside 180 mm. from entrance to back, and 200 mm. from top to bottom, giving a more globular flask shape.

Two nests contained four eggs, the other five. The eggs are ovate in shape, smooth in texture, and almost without gloss; white in color, unmarked.

The eggs measure as follows:

Set No. 1	Set No. 2
16 4 × 11	15.9 × 11.1
16.7 × 11	17.2 × 11.3
16.7 × 11.1	17.5 × 11.5
16.9 × 11.4	17.5 × 11.4

Before the eggs were laid two birds were sometimes seen about the nest sites, but later only a single bird. The adults flushed only when the nest was closely approached and then flew some distance and were then very difficult to collect. The male evidently takes part in incubation as on September 12 when visiting a nest the male flushed from it and was collected. It was the only bird in sight.

Two males with enlarged testes had the left testis somewhat slightly larger than the right.

Lonchura nevermanni Stresemann

Lake Daviumbu: 11 ♂ ad., 10 ♀ ad., 3 (sex ?) ad.; August 19–September 29.

Wing: ♂ ad. (10) 49–54 (av. 52.5); ♀ ad. (10) 49–56 (av. 51.9).

There is some variation in the series of each sex but most females have the clear grayish white restricted to the forehead, the top of the head and nape having the feathers brown, tipped with grayish white though two specimens sexed as females resemble males; the upperparts average duller and the upper tail-coverts are paler than in males. Below the females average slightly paler. Occasional specimens of both sexes have a faint broken blackish line extending up the middle of the lower breast from the abdomen.

Dr. Nevermann discovered this species in 1933 at Merauke and Mapa, in south Dutch New Guinea (1935, Mitt. Zool. Mus. Berlin, XX, pp. 462, 463), and recorded that he found large flocks of brown weaver birds, probably this species, common in the grass country, along the coast and extending 70 km. inland between Merauke and Frederick Hendrik Island. He collected twelve specimens.

It was next found by our 1936 Expedition. About Lake Daviumbu, the only place we saw it, it was a common species of the tall reeds and the floating mats of rice grass of the marshes and lagoons, and the tall grass of the savanna near the lake and lagoons. Probably the habitat in which it feeds depends on where the grass is fruiting. It is typically lonchura-like in habits, feeding in couples or small parties, sometimes mixed with other grass-frequenting species such as *Neochmia* and *Lon-*

chura stygia or more often in parties of its own kind, occasionally up to twenty or thirty in number. The individuals of the flock rise together and fly some distance when alarmed.

While it feeds commonly in the marsh with *L. stygia,* it feeds on the tall densely grassed savanna more than does that species and probably nests on the savanna judging by the actions of a mated pair, the female ready to lay, which I collected on such a savanna ridge. This breeding pair collected on September 8 were the only birds of the twenty-four collected which were in breeding condition.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. No. 21

ON SOME NEW GUINEA BIRDS

BY A. L. RAND

The following are the results of further study of the bird collections made in south New Guinea by the 1936–1937 Expedition.

Amaurornis olivacea ruficrissa (Gould)

Daru: 1 ♂ ad.; March 3, 1936.
Wuroi: 1 (♀?) (Native skin); 1934.
Dogwa: 1 ♀ juv.; February 25, 1934.
Wing: ♂ 150; ♀ (?) 131.

For comparison I have 2 males and 4 females (wing: ♂ 156, 158; ♀ 134, 138, 141, 142) from Arfak, Ifaar and southeast New Guinea and 5 males and 4 females (wing: ♂ 142, 143, 144, 145, 152; ♀ 129, 137, 139, 142) from Cape York and Bellenden Ker in Queensland.

The single south New Guinea male differs from the two other New Guinea males in possessing an enlarged, reddish base to the culmen and in having the under tail-coverts more rufous. In these characters it agrees with the Australian specimens though the reddish enlargement at the base of the culmen is not as great as with them.

The adult females from Australia have at most but a trace of the reddish base to the culmen, and it is as pronounced in a southeast New Guinea female as in any of the series of females.

The Australian and south New Guinea females have rufous under tail-coverts but the southeast New Guinea female has as rufous under tail-coverts as some of the Australian birds.

This appears to be the first record of this race for New Guinea.

Myiagra cyanoleuca (Vieillot)

Lake Daviumbu: 1 ♀ ad.; September 2.
Wing: 86.

This specimen, in fresh plumage, shows no significant differences when compared with somewhat worn specimens from Victoria. The male taken at Rona, March 10, by the 1933 Papuan Expedition was the first record for the mainland of New Guinea for this species. It has long been known from the Louisiades, Woodlark Island and the D'Entrecasteaux Islands.

Dicrurus bracteatus Gould

Bugi: 1 ♀ ad.; January 3, 1937.

Daru: 1 ♂ ad., 2 ♀ imm., 1 (sex ?) ad., 1 (sex ?) imm.; March 6, 1934, March 14 to April 7, 1936.

Gaima: 5 ♂ imm., 3 ♀ imm.; November 10 to 20, 1936.

This series is plainly distinct from the Papuan form in: the greenish, rather than bluish-purple reflections of the iridescent spots on the upper parts and breast, and of the wings and tail; in the longer bill, and in the lesser extent of the feathers over the base of the bill and the nostrils, so that the nostrils are less heavily concealed, and more of the culmen toward the base is exposed. The bill is actually longer than in *carbonaria,* and this reduction of the feathering at the base makes it appear still more so.

In coloration the present specimens cannot be distinguished from a series of Queensland birds. The measurements of the adults compare well with those of the Queensland birds measured and the bill measurements of the immature specimens approach the bill measurements of the Queensland adults.

This form is definitely different from *carbonarius* and the question arises whether or not it is a different species.

The species *bracteatus* in Queensland breeds from October to January (North, 'Nests and Eggs of Birds Found Breeding in Australia and Tasmania,' I, pp. 85–88). At Cape York, Barnard recorded it as very common and migratory, coming from New Guinea in large numbers in October (Mathews, 'Birds of Austr.,' XII, p. 286).

In November, at Gaima, drongos were common, and the actions of many of them strongly indicated that they were migrating. They were commonly seen singly, in pairs, or in small parties flying thirty to sixty yards up over the savanna and over the forest. They all appeared to be moving toward the southeast; that is, parallel to the river, as though working down to the end of the point of land between the Fly and the Bamu before crossing to Australia. This interested me in the possibility of the Australian birds being present, so that I collected a series of nine birds at this camp. Eight of them proved to be of the Australian type not in breeding condition, while only one was of the purplish Papuan type. Based on this evidence alone it would appear that the

Australian form was only a migrant to south New Guinea. But later, in January, Tate secured a bird of the Australian type at Bugi, which was in breeding condition. The March and April specimens from Daru in worn dress or molting, and none in breeding condition, indicate nothing as to migration or residence.

The evidence as to *D. bracteatus* as a breeding bird within the range of *carbonarius* rests on the Bugi specimen. While no other specimen of drongo was collected at Bugi, a series from Tarara, 20 miles inland and to the northwest (1936, 1937), and from the Oriomo River about 20 miles inland (1934), were all *carbonaria.* All the Daru drongos collected (five specimens) were *bracteata.*

Salvadori (1881, 'Ornith. del. Pap. e del. Molucc.,' II, p. 175) has already recorded *bracteatus* from 150 and 200 miles up the Fly River (D'Albertis coll.) in June. These could have been migrants from Australia.

It appears that some of the Australian *bracteatus* migrate to south New Guinea to spend the Australian winter while some breed in south New Guinea so that *bracteatus* must be considered a separate species and the rest of the forms hitherto included in *bracteatus* must be grouped under the next oldest name *carbonarius* Bonaparte, 1850, 'Consp. Gen Avium,' I, p. 352, "Nov. Guinea," with its type locality restricted to Lobo by Stresemann (1923, Arch. für Naturgeschichte, p. 46).

	MALE ADULT		MALE IMMATURE		FEMALE ADULT		FEMALE IMMATURE	
	WING	BILL[1]	WING	BILL[1]	WING	BILL[1]	WING	BILL[1]
carbonarius								
South New Guinea	150, 151, 152, 154	32, 30, 32.5,	140, 140, 141, 144, 147	28, 30, 30, 31.5, 30	140, 140, 141, 144, 147	28, 30, 30, 31.5, 30	135, 138	28, 27
bracteatus								
South New Guinea	156	34	147, 150, 152, 153, 161	35, 34, 35, 35, 37.5	157	35	140, 145, 144, 147, 150, 157	33, 33, 35, 35, 33.5
Queensland	154, 155, 158, 163, 165, 165, 165, 167, 169	36, 36.5, 36, 37, 36, 36, 37.5, 36.5, 36			148, 149, 149, 154, 158, 159, 159, 162, 166	35.5, 32, 32.5, 35, 35, 34, 35, 35.5	148, 155	34, 37

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[1] Culmen from base.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 22

ON THE BREEDING HABITS OF SOME BIRDS OF PARADISE IN THE WILD

BY A. L. RAND

The breeding habits of the birds of paradise have attracted much attention because of the strange and beautiful displays of the males. Most of the displays have been described, but the observations have almost all been on captive birds. The rôles of the male and female in courtship and nesting remain unknown for most species. The 1936 New Guinea Expedition spent considerable time and effort in attempting to gain information on these birds. As detailed below I found that one of the least specialized birds of paradise, *Manucodia ater*, is monagamous, and male and female share nest duties; that *Phonygammus keraudrenii* is usually seen in pairs and the male displays to the female; and that the male *Cicinnurus regius* is, for long periods, the sole occupant of a small area, one or two tree tops, in which it calls frequently and which probably is its territory.

Manucodia ater (Lesson)

At Lake Daviumbu in August and September this was a common forest species, feeding in the fruiting trees and spending most of its time in the lower parts of the forest canopy, and the tops of the lower trees. It was frequently found in pairs and was not especially wary. When nervous these birds give a quick little flit to their tail and have a deep "chug" call repeated a number of times, apparently expressing alarm or annoyance. A call, commonly heard at this camp and which I think was given by this bird was a drawn-out, whistled call and is probably similar to the "long-drawn moaning cry" recorded for *M. jobiensis* by Claude Grant (1915, Ibis, Jub. Sup., p. 9). In addition I have heard a low chattering call given at the nest (see below). In flight these birds have the heavy, silken, rustling of wings common to many birds of paradise.

On September 22, I was watching a *Manucodia* feeding in a seventy-foot fruiting tree in the forest. Another came into the tree and was at once chased some distance, both birds disappearing from sight through the forest. Trying to locate the birds again I saw one, apparently adult, sitting in the top of a tree twenty yards from the fruiting tree. It sat there quietly some time, preening its feathers. Then another came flying through the forest to perch there below it. The first bird began to shake its slightly spread wings and tail and hopped down near the new arrival. The second bird flew to another branch ten feet away followed by the first bird. The latter again shook its wings and tail and erected its body feathers for a moment. Then both flew off through the forest. Possibly this is part of the display of this species.

During my stay at Lake Daviumbu I found two nests and was able to get some information on the rôle of the parent birds.

Nest No. 1, September 21, 1936

This was in a small leafy thirty-foot tree growing in the rain forest beside the track, where a break in the forest canopy allowed the tree the full light of the sky. The nest itself was twenty feet from the ground among the smaller branches of a lateral bough so that it had several supports and was fairly well concealed from both above and below by the foliage.

The nest itself was a deep, firm cup composed chiefly of slender, soft woody or semi-woody stems which had been bent and woven around so as to make the nest a rather neat structure. It rested on several small forking branches, but on one side some of the stems forming the nest had been carried around a small branch to anchor it more firmly. Most of the material of the nest was dead and dry, but there were a few green stems of some creeper in the bottom of it. The outside of the nest was composed of stems of a number of kinds of plants. In the bottom of the nest, after the first layer of stems, a considerable number of dead leaves had been laid flat, and on top of this was a considerable quantity of dead, dry, rotten wood. This was completely covered again by the inside layer, composed entirely of blackish, semi-woody stems, bent around, making a rather rough interior, but there was no further lining.

The nest measured: outside—250 × 140 mm. deep; inside—130 × 100 mm. deep.

The walls were 60 mm. in thickness on one side, 20 mm. and open enough to see through on the other. On one side the cup-shaped nest has a sharp edge, on the other it is carried out as a flat open-work lip.

Nest No. 2, September 12, 1936

This was in a thirty-five foot, slender, open substage tree in the occasionally flooded open forest between the lake shore and the savanna. It was twenty-five feet up, resting on a number of lateral branches of several forks and with part of the nesting material carried around one branch to anchor it more firmly. It was in a rather open place where it could be seen from 75 yards distance. It was similar in material and construction to nest No. 1, though the edge was more irregular.

Eggs

Each nest contained two eggs. The eggs from nest No. 1 were ovate in shape; shell fairly smooth with a slight gloss. In color they were more heavily marked than the egg of this species figured by Hartert (1910, Nov. Zool., XVII, Pl. x); ground color whitish, in one egg spots and dots of blackish brown are scattered over it, and with many spots overlaid with whitish to give secondary grays; some parts of the egg irregularly suffused with pale purplish gray or with yellowish brown, giving a dirty appearance to the egg. The other egg was more heavily marked, with lighter colored markings tending toward streaks, especially about the largest circumference of the egg.

Measurements.—26.8 × 39.2 mm.; 25.7 × 39 mm.

Period of Incubation

Nest No. 2, discovered on September 12, was climbed to by natives who said it contained no eggs. On September 16 there were two eggs and on September 29 there was one small young and one egg still unhatched. Thus the period of incubation is more than fourteen days and less than eighteen days.

Description of Young

Probably a day or so old. This was from nest No. 2, September 29. The young was without a trace of down. Its skin was blackish flesh, paler below; bill grayish flesh, gape white, inside of mouth, flesh; feet grayish flesh.

Actions of Young

After I kept this young one alive overnight and it had been without food for about thirty hours, it was very weak but still begged for food when disturbed. This was such a dominating urge that it begged for food even after it had fallen on its back.

Adults About the Nest

Nest No. 1.—When the natives told me of this nest on September 21, I went at once to see it, knowing what accidents can befall nests. As I approached to within twenty yards of the nest the female (?) flew off, and in a moment, followed by another bird, flew back over the nest into a tall tree nearby. For some time one bird went to and from the nest, apparently too nervous to incubate. For fear of causing it to desert the nest I hastily prepared a watching place ready for the morrow, and departed. I had seen the second bird but once and neither bird had made any sound about the nest. Next day I found that one of our boys, not knowing the nest was there, had climbed the tree and cut off the very branch with the nest, in order to examine and collect the flowers of this tree. The eggs evidently have a very tough shell as I found them both on the ground, one only slightly cracked, the other entire.

Nest No. 2.—I watched this nest several times between September 16 and September 19. At this time it contained two eggs. I sat in an exposed situation about forty yards from the nest. Both my unconcealed position and the proximity of our temporary camp only sixty yards from the nest, may have influenced the actions of the birds.

I found that I could approach to within twenty yards of the nest before the brooding bird slipped off. It returned in a few minutes to resume brooding, but if the intruder had not left it went away again and stayed away for a long period.

During the time I spent watching the nest apparently only one bird came to the nest. The periods the bird brooded and the periods it was absent from the nest are listed below:

September 16—period of observation—from 3:55 P.M.–5:17 P.M.:

Bird Brooded	Bird Absent from Nest
24 minutes	22 minutes
33 minutes	23 minutes

September 17—period of observation—from 10:10 A.M. to 1:35 P.M.:

Bird Brooded	Bird Absent from Nest
	45 minutes
51 minutes	10 minutes
21 minutes	51 minutes
22 minutes	5 minutes

During the five hours and seven minutes which I spent watching the nest, the incubating bird, presumably the female, brooded on five different occasions for intervals ranging from 21 to 51 minutes and was absent from the nest for six periods ranging from five to fifty-one minutes.

When the brooding bird left the nest it usually flew silently away out of sight through the forest away from the camp. Returning, it usually flew to several perches on its way to the nest, finally lit on the nest bough and hopped along that to the nest. It was always silent. Though I could see forty to fifty yards along the route the bird took, I did not see another bird. Presumably the female alone brooded.

Since the male did not come to the nest I attempted to find if the brooding bird joined its mate. On the afternoon of September 17, I watched along the route usually taken by the brooding bird in leaving the nest. It left the nest and flew to a big tree in the edge of the forest seventy yards from the nest. Here it gradually worked up to the top of the tree then flew one hundred yards across the small area of savanna to a yellow-flowered forest tree (*Xanthostemma*). Here it began to feed leisurely among the blooms, pecking at the flowers, with frequent pauses. After about five minutes it was joined by another bird which came hopping up from lower in the tree where I hadn't seen it. For a time both fed within a few feet of each other. Though they sometimes approached within six inches of each other they paid no apparent attention to one another. Shortly the female (?) flew a short distance to a leafy tree, followed by the other; both rested here for about five minutes, then one, followed by the other, flew to the big tree already mentioned, seventy yards from the nest. Here I couldn't see them, but shortly one flew back across the savanna, while in fifteen minutes the other came to the nest to brood. I had heard no sound from these birds during this period.

Again, on September 19, I saw the female (?) leave the nest and fly the seventy yards to the forest edge where it was joined by another bird. Both flew across savanna to forest beyond, apparently supporting the observations of September 17, that the female joined the male when she left the nest to feed.

We moved our camp on September 20 and on September 29 I returned to this nest to continue observation. I was fortunate in that, as I found later, one egg had recently hatched, while the other was nearly ready to hatch. From a "hide" of boughs about 65 yards from the nest I watched the actions of the birds.

I arrived at the nest at 8:15 A.M. and heard the female calling "chug chug - - -" before I saw it. It was sitting by the nest, nervously jerking its tail and looking about. While I was making the "hide" the female flew about in the vicinity. Then the natives who were helping me left and the female at once returned to the nest, at 8:31. It stood looking into it for a moment, then hopped on and began to brood; twenty-two minutes later I saw a male fly into a nearby tree. In a moment the female left the nest, having brooded for forty-five minutes, and flew directly away. As it disappeared the male came to the nest, stood looking into it for a moment, then hopped on and brooded. Thirty-five minutes later the female came sailing to perch just below the nest, the male then rose off the nest and flew away. The female stood a few moments occupying itself with the contents of the nest, perhaps with feeding and nest sanitation, then settled to brood. Thirty-nine minutes later the male came sailing into the nest tree; one bird gave a low chattering call and I heard the drawn-out whistled call, given, I think, by one of these birds. Then the female left and the male went to the nest in a moment, spent two minutes in what appeared to be feeding and nest sanitation, then brooded. This established definitely that both of the pair share in the nest duties.

After a few moments I attempted to get close enough to shoot the bird, but it was wary, and though I waited another hour I was unable to secure it. The somewhat larger bird I have considered the male in the above notes.

The male sat rather quietly while brooding; the female was rather nervous and kept turning about during the period at the nest.

This species is not particular about nest sanitation and the brooding birds apparently mute over the edge of the nest. When I collected the nest I found a quantity of accumulated droppings on the branch supporting the nest.

It appears that this unspecialized bird of paradise may pair monogamously, after the manner of many passerine birds, and that the male and female share in the nest duties.

From the above the male evidently assists in brooding when the young hatch and probably in feeding the young. The earlier observations indicating that the male does not approach the nest during incubation, but stays in the vicinity and is joined by the female when she leaves the nest to feed, may represent the usual condition or it may be that the male was shyer than the female and the unaccustomed human activity near the nest frightened it so that it did not take its accustomed turn at incubation.

Phonygammus keraudrenii (Lesson and Garnot)

This was a fairly common species at Tarara, Wassi Kussa River, where it is usually found in substage trees and tree tops in the rain forest. It was usually seen singly or in pairs and came to fruiting trees to feed. Its call, commonly heard, was a loud harsh squawk, somewhat recalling the call of *Mino dumonti.*

On December 12 I heard one of these birds, and saw one, then another, fly to a large, horizontal exposed branch thirty feet up. They were male and female, judging by their difference in size. They perched a foot or so apart, the male turned toward the female and depressed the forepart of its body so that it was more or less parallel to the branch on which they sat. The male then slightly raised and spread its wings, erected its body feathers and gave a single loud, slightly prolonged harsh call, relaxing its feathers and folding its wings as it did so. Then the male moved toward the female which flew fifty yards into the forest where the performance was repeated. Apparently the chasing and display continued for some moments, though, due to the density of the foliage and frequent movements of the bird I could catch only an occasional glimpse of them. Apparently this display was given solely for the benefit of the female.

The above is evidently the mating display of this species and, from this and the fact that the species is frequently, perhaps usually, found in pairs, one may perhaps conclude that this bird is monogamous and that both male and female take part in the nest duties, as in *Manucodia.*

This conclusion is in accord with the observations on the Queensland race *P. k. gouldi.* The nest and eggs of *P. k. gouldi* have been described a number of times and in Mathews ('Birds of Australia,' XII, pp. 385–387) it is recorded that at several nests a pair of birds was present.

With the above evidence as to the nest of this species, it seems that Frost was mistaken in reporting (Rothschild, 1930, Bull. Brit. Ornith. Club. LI, p. 9) that this species had the habits of parasitic cuckoos.

Cicinnurus regius (Linnaeus)

On July 6, two miles below the Junction of the Black and Palmer rivers I spent more than half an hour trying to get a view of a male of this species which was alternately sitting quietly and then moving quickly about in a very dense substage tree.

Later, at the camp on the Fly River opposite Sturt Island, where this species was also common, I again found adult males spending much of their time for long periods alone in a medium-sized, densely leaved, shrubby forest tree.

At one such tree near camp I first recorded a male in it on October 10 and from then to October 31, I visited this tree almost daily, and at various times during the day. Each time the male was in the tree. The presence of a fruiting liana, on the fruit of which many species of birds fed, perhaps even made it unnecessary for the bird of paradise to leave for food, though I did not see it feeding on this fruit.

Several times I watched this tree for a few hours at a time in the hopes of seeing some sort of display, but in vain. The bird spent long periods sitting quietly in the interior of the tree, frequently calling a harsh "caaar," somewhat drawn out and plaintive.

When it moved about its actions were quick and active. One of its characteristic actions was to fly down and alight on a small vertical branch or liana, and hop up it, reversing its body at each hop. I saw several other species of passerine birds in this tree and the king bird of paradise paid no attention to these intruding birds. Occasionally I shot a bird in or near this tree. The shot did not frighten the king bird of paradise from the tree; indeed sometimes the sound of the shot stimulated it to call.

Other males apparently had similar posts nearby, to which they kept, judging by their calls, which I heard day after day when at this one tree. But each male was alone in its tree.

Unable to observe another king bird of paradise come to the tree, I arranged a mounted male and a female and introduced them at different times into this tree. The results were negative. The male simply came and inspected them, then retired twenty or thirty feet from them and sat quietly watching.

When I sent a boy up into the tree, the male flew about calling a hissing "chee" of protest, returning to its tree as soon as the boy descended.

Probably this single tree, or sometimes two trees close together, represents the territory held by one male and to which the female comes to mate.

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STUDIES OF PERUVIAN BIRDS. NO. XXIX[1]

THE GENERA *MYIARCHUS*, *MITREPHANES*, AND *CNEMOTRICCUS*

BY JOHN T. ZIMMER

I am greatly indebted to Dr. Herbert Friedmann of the U. S. National Museum, Washington, D. C., for the loan of certain critical material used in the following study.

Names of colors are capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

Myiarchus tyrannulus tyrannulus (Müller)

Muscicapa Tyrannulus P. L. S. MÜLLER, 1776, 'Natursyst.,' Suppl., p. 169—based on DAUBENTON, 'Pl. Enl.' 571, fig. 1; Cayenne.

Muscicapa aurora BODDAERT, 1783, 'Tabl. Pl. Enl.,' p. 34—based on DAUBENTON, *loc. cit.;* Cayenne.

Myiarchus erythrocercus SCLATER AND SALVIN, 1868, P. Z. S. London, pp. 628, 631—Caracas, Venezuela.

Myiarchus tyrannulus chlorepiscius BERLEPSCH AND LEVERKÜHN, 1890, Ornis, VI, p. 16—Cuyabá, Matto Grosso, Brazil; cotypes in Kiel Mus.

Santa Ana, Urubamba Valley, 1 ♂; Jaen, 1 ♂; Pucará, 1 ♂.

Peruvian specimens are quite inseparable from Paraguayan, Argentine, Bolivian, and some Matto Grosso specimens and belong to the same form as these southern examples, whatever the latter may be called. Presumably, the name "*chlorepiscius*" is applicable to this population if it can be distinguished from its conspecies. In the original description of "*chlorepiscius*," comparison was made with "*tyrannulus*" of Venezuela and Bahia, a grouping which includes the forms *tyrannulus* (as at present restricted) and *bahiae*. Interestingly enough, the Matto Grosso birds in series show the characters of both these forms, in one degree or another. In particular, the Chapada specimens, representing the Madeira-Amazonian drainage, are equivocal while skins from the Rio Paraguay Valley, which includes the type locality of "*chlorepiscius*," are more consistently like *tyrannulus*. If the name "*chlorepiscius*" can be used, therefore, it may reasonably be applied to the birds with a relatively broad strip of rufous on the inner margins of the outermost rectrices, as in *tyrannulus.*

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[1] Previous papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, 917, 930, 962, and 963.

I am unable, however, to find any definite characters for the distinction of "*chlorepiscius*" from *tyrannulus.* Series from the northern part of South America show the same variation between the same extremes as do examples from the south. The case is comparable to that of *Myiarchus ferox australis,* discussed on another page. As in the case of *australis,* there is a decided difference in the season of molt in the two populations. The southern birds molt from January to March, rarely as late as June; the northern birds, from June to October or November. The northern population inhabits the low Tropical Zone; the southern one, a dilute Tropical Zone or moderately warm highland area, partly south of the Tropic of Capricorn. Neither population appears to be migratory.

Hellmayr refers two specimens from the Rio Branco, Brazil, to *tyrannulus.* I have three specimens from the Rio Surumú and three from the Rio Cotinga, both tributaries of the Rio Branco, and find all six examples like others from Faro, Monte Alegre, and Ilha São Luiz (Maranhão). They agree with *bahiae* in the absence of rufous inner margins of the outer rectrices but approach *tyrannulus* in the somewhat darker coloration of the back and the top of the head. For the present I refer them all to *bahiae,* although they are distinguishable from most of the Bahian specimens. Bahian birds are far from uniform. One or two examples are as dark as the Faro birds; most of them are decidedly paler. Southern Maranhão skins are all relatively pale (like the paler Bahian birds) as are three Ceará examples. Four skins from Goyaz (Rio Araguaya) are the palest of any at hand. Ceará is the type region for "*pallescens*" but the specimens at hand from that state, like the Maranhão and Goyaz examples, lack the development of rufescence on the outer rectrices which is given as one of the characters of the supposed Ceará form.

One female of *tyrannulus* from Cayenne has the rufous of the outermost rectrices reduced to a small area toward the base of the inner webs and other examples from the same locality have the rufescence duller and less sharply defined than in the Venezuelan and Colombian series. There is thus some approach toward *bahiae* even in the type locality of *tyrannulus.*

It may be noted that *bahiae* is found on the lower Tapajoz and it is probable that it ranges up that stream to the Matto Grosso highlands, since, as stated on an earlier page, some northern Matto Grosso specimens are like *bahiae*, some like *tyrannulus*.

Records of *tyrannulus* from Perú are from Maranura, Bellavista, Yurimaguas, and Sarayacu.

SPECIMENS EXAMINED

M. t. tyrannulus.—FRENCH GUIANA: 9. BRITISH GUIANA: 1. VENEZUELA: 64. TRINIDAD: 8. MONOS ISLAND: 1. MARGARITA ISLAND: 2. TESTIGOS ISLANDS: 1. COLOMBIA: 51. BRAZIL: Matto Grosso region, 34. PARAGUAY: 15. ARGENTINA: 13. BOLIVIA: 8. PERÚ: 3.

M. t. bahiae.—BRAZIL: state of Bahia, 16; São Paulo, 6; Piauhy, 7; Maranhão, 13; Goyaz, 4; Ceará, 3; Rio Xingú, 1; Rio Majarý, 1; Rio Tapajoz, 9; Rio Jamundá, 2; Monte Alegre, 1; Rio Surumú, 3; Rio Cotinga, 3.

Myiarchus swainsoni pelzelni Berlepsch

Myiarchus pelzelni BERLEPSCH, 1883 (April), Ibis, p. 139—Bahia; Frankfort Mus.

I can find no sharp line of demarcation between *pelzelni* and *swainsoni* sufficient to justify the maintenance of specific separation. Aside from the darker color of *swainsoni*, there is one factor which is of particular service in the separation of individual specimens. This is the relative prominence of the pale tips on the greater and middle upper wing-coverts and of the pale outer margins on the inner secondaries and tertials. In *pelzelni* these markings are whitish or yellowish white, broad and conspicuous; in *swainsoni*, the tips of the two series of wing-coverts are much duller, grayish or brownish in tone, though paler than the median portion of the feathers, and the outer margins of the secondaries and tertials are very narrow, though whitish or yellowish white. Typical *pelzelni* has the throat and chest snowy white, instead of grayish, and the belly clearer yellow than in *swainsoni*, which has a grayish suffusion, particularly on the latero-anterior portion of this region. *Swainsoni* also has the upper parts distinctly darker, particularly on the top of the head, and usually has the lores brownish, not in contrast to the adjacent areas of the head.

Intergradation between the two forms appears to take place in Paraguay. Specimens from east of Caaguassú and east of Villa Rica are rather typical *swainsoni*, but a skin from Colonia Risso and another without definite locality, are a little paler on the upper parts than the average and have more prominent pale wing-bars. None of the Paraguayan specimens are near the maximum of *swainsoni* in dimensions although they come within the range of variations of both *swainsoni* and *pelzelni*. Intergradation between *swainsoni* and the still larger *ferocior* may be presumed to occur in Uruguay where *ferocior* is reported to exist in the western part of the country and *swainsoni* in the east.

All of the dated specimens of *swainsoni* at hand from southeastern Brazil and Paraguay were collected between September and early April. All from the northern border of Brazil, British Guiana, and Venezuela were obtained during the period from April to September. Apparently, therefore, *swainsoni* is a migrant from its southern range (Rio de Janeiro south to Rio Grande do Sul and eastern Uruguay and west to Paraguay) during the winter months. The northern specimens are quite indistinguishable from the southern ones except that the northern examples are almost all in some stage of molt, beginning, apparently, in April and ending just before the southern journey in September.

It is difficult to find characters for the constant recognition of *ferocior*. In size, it is larger than *swainsoni* and *pelzelni*, but there appears to be some overlap. The upper parts are much as in *pelzelni*, but the under parts are duller, with the throat and chest less purely whitish and the belly less clearly yellow, though more yellowish than in *swainsoni*. The wing-markings are even more pronounced than in *pelzelni*. The lores, which are brownish in *swainsoni* and pale grayish or whitish in *pelzelni*, are darker than in either of the others and appear to have a dusky tone either just in front of the orbit or extended over the entire loral area. The bill is pale, as in *pelzelni*, but inclined to be a little larger.

This form finds its center of distribution in northern Argentina, extending northward into southeastern Bolivia and southeastward into western Uruguay, according to authors. One skin from the Province of Sara, Bolivia (March), may be a resident individual. Two specimens from Todos Santos, Bolivia, were taken in July and there is a possibility that they represent no more than migrants from more southern regions. Additional material from Bolivia will be needed to determine the status of the species in that country. A single bird from Trinidad, Río Mamoré, is *pelzelni*, perhaps the resident form in the north.

A specimen from Florencia, eastern Colombia, which was referred to *pelzelni* by Todd and Hellmayr, but to "*fortirostris*" (= *ferocior*) by Chapman, agrees much better with *ferocior* than with the Bahian form, having the chest dark and grayish, instead of white, the belly relatively pale and dull, the lores somewhat shaded with dusky, and the wing-markings very prominent. This specimen was collected in June and rather certainly represents a migrant from the south. Another Colombian bird, from La Herrera, south of Bogotá, collected in May, is decidedly closer to typical *swainsoni* of which it appears to be a wintering individual.

Barrows (1883, Bull. Nutt. Orn. Club, VIII, p. 202) suspected the migratory tendencies of *ferocior* which he found to appear in western Uruguay on November 20. All our specimens of this form from Argentina are dated in November, December, and middle March.

A single example from Chauillay, Urubamba Valley, Perú, dated July 10 but without given sex, is slightly darker than typical *pelzelni*, not so clear white on the chest as that form but more whitish than in *ferocior* and about as clear yellow on the belly as *pelzelni*. The resemblance is greatest to a series of birds from the Matto Grosso region of Brazil which, in general, is most nearly like true *pelzelni*. Other Peruvian records, from Santa Ana, Urubamba Valley, are dated June 16, July 12, and December 19. If these records all belong to the same form, it should be the form resident in the region. Judging by the Urubamba Valley skin now at hand, this form is *pelzelni*. Nevertheless, there is one Peruvian specimen which is referable to *ferocior*, apparently a migrant from farther south. It is discussed under the heading of *ferocior*.

A single specimen, without sex, from Tapará, Rio Xingú, is quite typical *pelzelni*, and a badly worn skin from the island of Mexiana also appears to belong to this form. The range of *pelzelni* thus may well extend northward from Bahia to the Xingú as well as westward across Matto Grosso and northern Bolivia to eastern Perú. Specimens from the Tapajoz and the Madeira, on the south bank of the Amazon, and from Faro and the lower Rio Negro, north of the Amazon, are not to be so assigned, nor are they referable to *ferocior* or *swainsoni*. Since they have no available name, they are described below.

Myiarchus swainsoni ferocior Cabanis

Myiarchus ferocior CABANIS, 1883, Jour. für Orn., XXXI, p. 214—San Javier, Tucumán, Argentina; Berlin Mus.

Myiarchus (?) *fortirostris* TODD, 1913 (August 8), Proc. Biol. Soc. Wash., XXVI, p. 171—Prov. del Sara, Bolivia; ♂; Carnegie Mus.

A single specimen from "E. Peru" in the U. S. National Museum, Washington, D. C., without date or exact locality, agrees with Argentine and east-Bolivian specimens in dull ventral coloration, dark lores, and very broad pale tips on the upper wing-coverts. It is quite readily distinguishable from the Urubamba Valley bird that I have referred to *pelzelni* and compares well with the skin from Florencia, Colombia, that has been placed with *ferocior*. Presumably, like the Florencia specimen, this example represents a migrant from farther south. A more detailed discussion of *ferocior* is given under *pelzelni*.

It is possible that some of the other records from Perú (Santa Ana, Urubamba Valley) also may belong to *ferocior* but the matter can not be determined without an examination of the pertinent specimens. Two of the Santa Ana birds have been determined by Hellmayr as *pelzelni*. There are no other Peruvian records.

Myiarchus swainsoni amazonus, new subspecies

TYPE from Faro, Brazil. No. 284,359, American Museum of Natural History. Adult male collected November 29, 1930, by the Olalla brothers.

DIAGNOSIS.—Nearest to *M. s. pelzelni* of Bahia but darker; upper parts as dark as in the paler examples of *M. s. swainsoni* and with similar contrast between the back and the still darker and browner cap; under parts intermediate, with the throat and chest less whitish than in *pelzelni* but not so strongly grayish as in *swainsoni;* belly slightly shaded with grayish, less strongly than in *swainsoni;* wing-marking strongly developed as in *pelzelni;* lores paler than in *swainsoni* or *ferocior;* size that of *pelzelni*.

RANGE.—Both banks of the lower Amazon, from the Madeira to the Tapajoz and from the lower Rio Negro to the Jamundá; extending northward to French Guiana and the lowlands of British Guiana.

DESCRIPTION OF TYPE.—Back Deep Olive, including the shorter upper tail-coverts; longer upper tail-coverts distinctly browner with somewhat rufescent margins; whole top of head Brownish Olive × Olive Brown with darker centers; auriculars slightly darker over most of the area but tinged with grayish along the lower border; lores dull olive-grayish; malar region and sides of throat near Gull Gray; sides of breast darker and tinged with brownish; center of throat and chest paler, near Pallid Neutral Gray; belly Marguerite Yellow × Primrose Yellow, with a noticeable grayish suffusion latero-anteriorly; flanks tinged with dull olive-grayish; under tail-coverts like the middle of the belly. Wings dark brown with narrow, pale outer margins on the primaries, broader and clearer ones on the secondaries, and still broader and more prominent ones on the tertials; median and greater upper wing-coverts with relatively broad and conspicuous pale tips, extending basad along narrow outer margins on the greater series; lesser series like the back, with slightly paler tips on the lower row of feathers; under wing-coverts Marguerite Yellow; inner margins of remiges Olive-Buff. Tail Fuscous, very narrowly edged with grayish or grayish brown on basal part of outer margins, but with whole outer web of outermost pair somewhat paler than the inner web and with a still paler, narrow outer margin; tips of all rectrices paler and more grayish than the middle and basal portions, not at all sharply defined. Bill (in dried skin) light brown; feet darker brown. Wing, 88 mm.; tail, 82; exposed culmen, 16.25; culmen from base, 22; tarsus, 20.

REMARKS.—Female similar to the male but averaging a little smaller (wing, 84–88.5; tail, 73–78; males with wing, 87–90; tail, 76.5–82).

Two specimens from Annai, British Guiana, are inseparable from the Amazonian birds, although one of them is darker on the upper parts than most and shows an approach toward some of the series of *phaeonotus;* below, it is too pale on the chest and too yellowish on the belly for that form. Nevertheless, its characters are significant and suggestive of its relationship to *phaeonotus.*

Sixteen specimens of *phaeonotus* from the type locality, Merumé Mountains, British Guiana (one), Mt. Roraima, (five), and Mt. Duida (ten), are fairly uniform in their characters of sooty upper parts, clear gray throat and chest, only slightly yellowish belly, and strongly-marked wings. Nevertheless, there is some variation in the direction of *amazonus,* particularly noticeable in a topotype. There seems to be no good reason to keep *phaeonotus* specifically distinct from *swainsoni* and *pelzelni.* The wing-formula in *phaeonotus* is not perfectly constant, nor is it in the other related forms. The most common pattern in *phaeonotus* is that shown less often in *pelzelni, swainsoni,* and *ferocior* but quite commonly in *amazonus,* while the most common style in *pelzelni* occurs in some *phaeonotus.* In the characteristic wing of *pelzelni,* the 10th (outermost) primary is longer than the 4th and the 9th is longer than the 6th, but some specimens show the 10th shorter than the 4th or the 9th shorter than the 6th although the 9th appears always to be definitely longer than the 5th. So also in *phaeonotus,* the 9th is longer than the 5th, sometimes longer than the 6th. This appears to be the most constant feature of the wing for the whole *swainsoni* group. In *M. ferox,* the 9th primary is usually distinctly shorter than the 5th, rarely equal to it, and the 10th, except in rare cases, is shorter than the 4th.

A number of specimens from the middle and upper Rio Negro necessitate a reconsideration of *phaeonotus* as a strictly mountain-inhabiting form. An adult in nearly completely fresh plumage (sexed as a male but with the measurements of a female), from Cucuhy, is quite indistinguishable from Roraima and Duida birds. An immature bird from Cucuhy also is certainly *phaeonotus.* Two males from Tabocal and a male and two females from Yavanari, all in very worn condition, match similarly worn specimens from Mt. Duida and are noticeably darker than worn examples of *amazonus* from the lower Negro. Hence they must be placed with *phaeonotus* and the range of *phaeonotus* must be considered to extend about halfway down the Negro; that of *amazonus* does not extend far upstream from the mouth.

The skins at hand from Igarapé Cacao Pereira, on the right bank of the Rio Negro, a short distance above its mouth, are badly worn but are a little darker above than might be expected from an examination of fresher material. Nevertheless, they are paler than similarly worn examples of *phaeonotus*. The dark Annai bird, mentioned in the preceding paragraph, is not unlike the worn lower Rio Negro skins in general dorsal coloration although it is not so abraded.

A skin from Yucabi, upper Rio Negro (right bank) is much like *amazonus* in ventral coloration, but the upper parts are paler, less brownish and with a light greenish tone, particularly noticeable on the forehead. It lacks much of the dusky spot in front of the eyes that characterizes typical *ferocior* and is small for that form, but it does not fit in well with the series of *amazonus*. As a matter of fact, it resembles most two Paraguayan specimens (one from Colonia Risso and one without exact locality) which are intermediate between *swainsoni* and *pelzelni* and it may be a migrant from northern Paraguay. Paraguayan skins from near Villa Rica and near Caaguassú are rather typical *swainsoni*, as is discussed on an earlier page.

Specimens Examined

M. s. swainsoni.—Brazil: São Paulo, Ypanemá, 1 ♂ (cotype of *cantans* Pelzeln); Rio Grande do Sul, São Francisco de Paula, 3 ♂, 5 ♀; Nonohay, 3 ♂, 6 ♀; Vaccaria, 1 (?); Lagôa de Forno, 2 ♂, 1 ♀; Sananduva, 1 ♂; Lagôa Vermelha, 3 ♂, 3 ♀; Erebango, 2 ♂; Sinimbú, 1 ♂; west of São Lorenzo, 1 ♂; Rio de Janeiro, Monte Serrat, 1 (?); Santa Catharina, Palmitas, 1 (?); Paraná, Corvo, 2 ♂, 1 ♀; Porto Almeida, 1 ♂, 1 (?); Tibagy, 1 ♂; Rio Surumú, Frechal, 1 ♀[1]. Paraguay: east of Villa Rica, 2 ♀; east of Caaguassú, 2 ♀. British Guiana: Annai, 1 ♀[1]. Venezuela: Ciudad Bolívar 1 ♀[1]; Perico, 1 ♂[1]; Agua Salada de Ciudad Bolívar, 1 ♀[1]; Caicara, 2 ♂[1]; Río Cassiquiare, Buena Vista, 1 (?)[1]; Solano, 1 ♀[1]; Río Orinoco, mouth of Río Ocamo, 2 ♀[1]. Colombia: La Herrera, 1 ♀[1].

M. s. pelzelni.—Brazil: Bahia, Jiquy, 1 ♂; "Bahia," 3 (?); Matto Grosso, Tapirapoan, 1 ♀; Urucum, 1 ♂; Chapada, 4 ♂, 5 ♀; Rio Xingú, Tapará, 1 (?); Isla Mexiana, Santa Maria, 1 ♀. Perú: Chauillay, 1 (?). Bolivia: Trinidad, Río Mamoré, 1 ♀.

M. s. ferocior.—Argentina: Barracas al Sud, 1 ♂, 1 ♀; Ocampo, 1 ♂, 1 ♀; Tucumán, 1 ♂; above San Pablo, 1 ♂; La Plata, 1 ♂. Bolivia: Province of Sara, "Camp woods," 1 ♀; Todos Santos, 1 ♂[1], 1 ♀[1]. Colombia: Florencia, 1 ♂[1]. Perú: "E. Peru," 1 (?)[1,2].

M. s. swainsoni × pelzelni.—Paraguay: Colonia Risso, 1 (?); (no locality), 1 ♀. Brazil: Rio Negro, Yucabí, 1 ♀[1].

M. s. amazonus.—Brazil: Faro, 2 ♂ (incl. type); Rio Negro, Manaos, 2 ♂, 1 ♀; Igarapé Cacao Pereira, 3 ♂, 1 ♀; Rio Tapajoz, Igarapé Brabo, 2 ♀; Santarem, 1 ♂; Rio Madeira, Borba, 1 ♂; Santo Antonio de Guajará, 1 ♀. BRITISH GUIANA: Annai, 2 ♂.

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[1] Migrant.

[2] Specimen in U. S. National Museum, Washington.

M. s. phaeonotus.—BRITISH GUIANA: Merumé Mountains, 1 ♀; Mt. Roraima, 1 ♀. VENEZUELA: Mt. Roraima, Paulo, 2 ♂; Arabupu, 3 ♂, 1 ♀; Mt. Duida, Valle de los Monos, 1 ♀; Caño León, 2 ♂, 1 ♀; "Cumbre No. 1," 1 ♂, 1 ♀; Summit Camp, 1 (?); Chorrera de Vegas, 2 ♂, 1 ♀. BRAZIL: Rio Negro, (near) Cucuhy, 1 "♂" [? = ♀], 1 ♂; Yavanari, 1 ♂, 2 ♀; Tabocal, 2 ♂.

Myiarchus phaeocephalus phaeocephalus Sclater

Myiarchus phaeocephalus SCLATER, 1860, P. Z. S. London, XXVIII, p. 281—Babahoyo, Ecuador; cotypes in British Mus.

Specimens from Chilaco and Paletillas, Perú, are inseparable from west-Ecuadorian birds and are typical *phaeocephalus.* Records from Lechugal and Tumbez presumably represent the same form.

These localities, as well as those in western Ecuador, are all in the Arid Tropical Zone of the western side of the Western Andes, from sea-level up to about 1550 feet (Paletillas). Farther south, on the same side of the Andes but at a much higher elevation, either in the Subtropical Zone or adjacent to its lower margin (4000–6000 feet), is found the form *toddi,* discussed below. Across the Western Andes, on the eastern slope of the range at relatively high elevations (1450–5000 feet), the resident population of this species is recognizably distinct from that of the coastal region and may be known as follows.

Myiarchus phaeocephalus interior, new subspecies

TYPE from Perico, Río Chinchipe, Perú; elevation, 1450 feet. No. 182,126, American Museum of Natural History. Adult male collected July 14, 1923, by Harry Watkins; original No. 7449.

DIAGNOSIS.—Similar to *M. p. phaeocephalus* of western Ecuador and extreme northwestern Perú, but averaging smaller; top of head behind forehead with centers of feathers browner and less blackish and the margins browner, less grayish, giving a more uniform appearance to the area; back with a somewhat more brownish tinge and with the dark centers of the feathers paler than in *phaeocephalus* and less extensive, giving a decidedly less prominently streaked appearance; yellow of belly deeper in tone; margins of the secondaries and tertials more yellowish, less whitish.

RANGE.—Semi-arid Tropical Zone region on the eastern slopes of the Western Andes above the middle Marañón in northern Perú.

DESCRIPTION OF TYPE.—Most of top of head with centers of feathers brownish black, margined with Dark Olive; passing into dull Neutral Gray on forehead and darker gray on hind neck; back near Deep Olive with dull brownish central areas on the feathers, concealed and not very sharply defined from the tips even when the feathers are lifted; lores, sides of head, and superciliary region near Neutral Gray; chin and center of throat Pale Gull Gray, passing into Pale Neutral Gray on the chest and Dark Olive Gray on the sides of the breast; belly and under tail-coverts

Barium Yellow with a slight tinge of Straw Yellow; flanks suffused with light grayish olive. Wings blackish brown; primaries with very fine, pale outer marginal lines; secondaries with outer borders broader, Olive-Buff; tertials with borders still broader; greater and median upper wing-coverts broadly tipped with Light Grayish Olive, forming prominent wing-bars; lesser series colored like the back; under wing-coverts Primrose Yellow; inner margins of secondaries and tertials near Primrose Yellow; inner margins of primaries less yellowish. Tail brownish black or Fuscous with broad area at tips paler by comparison with the middle portions of the feathers but without any line of demarcation; outer web of outermost rectrix slightly paler than the inner web; outer margins of remaining rectrices colored like the back. Bill, in dried skin, blackish, somewhat browner on the mandible; feet blackish. Wing, 91 mm.; tail, 89; exposed culmen, 17.25; culmen from base, 23; tarsus, 20.

REMARKS.—Female similar in color but averaging somewhat smaller. Wing, 85–88 mm.; tail, 82.5–85. Males: wing, 89–93; tail, 87–89 (one specimen 96.5!). Typical *phaeocephalus* at hand measure as follows. Males: wing, 90.5–96 mm.; tail, 85–93. Females: wing, 85.25–91; tail, 82.25–93.

Chapman (1926, Bull. Amer. Mus. Nat. Hist., LV, p. 528) noted the differences between Marañón Valley birds and typical specimens from the western coast but did not give a name to the birds of the interior. With additional specimens from still other localities than those mentioned by Chapman, I find the characters quite definitive and the range distinctive, as shown above.

Myiarchus phaeocephalus toddi Chapman

Myiarchus toddi CHAPMAN, 1923 (April 11), Amer. Mus. Novitates No. 67, p. 10—Palambla, Perú; ♂; Amer. Mus. Nat. Hist.

The type of this interesting form remains unique so far as published records show. It is quite distinct from both *phaeocephalus* and *interior* although it is closer to *phaeocephalus*, being even grayer above than that form though with the same prominence of blackish centers on the dorsal feathers.

Hellmayr [1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 175] has suggested the possibility that *toddi* is an individual variant of *phaeocephalus*, devoid of lipochrom tints. So long as it remains known only from a unique specimen this possibility cannot be summarily dismissed. Nevertheless, there is an equal possibility that a perfectly valid subspecies exists at Palambla. Dr. Chapman concluded that the habitat of *toddi* is in the Subtropical Zone, but this conclusion also needs confirmation. The country about Palambla is described by Harry Watkins (the collector of the type of *toddi*) as above the true Arid Tropical Zone and below the Humid Temperate Zone, with some admixture of Subtropical (humid) terrain in the ravines although not, in general of a humid character. Obviously, some mingling of faunal elements occurs at this point as it does elsewhere under similar conditions and it is difficult to specify the exact zonal classification which should be used. The country occupied by *interior* has many of the same characteristics, being a high and semi-arid region with some Tropical Zone affinities.

Certain species of birds, with a range coinciding in part with that of *Myiarchus phaeocephalus,* show no subspecific distinctions in the regions embraced by the three forms of *phaeocephalus* here recognized. Others (such as *Xenops rutilans*) may show a distinction between the Marañón Valley and the coast or (like *Hylocryptus erythrocephalus*) between Palambla and the northern part of Piura. I have found no case exactly parallel to that of *M. phaeocephalus* although *Thamnophilus doliatus* is quite similar in some respects, differing principally by the much more extensive distribution of the Marañón form and by the more restricted and slightly more elevated range of the northern Piura form. The present case, therefore, is particularly interesting from a distributional point of view and more information respecting the Palambla resident is highly desirable.

SPECIMENS EXAMINED

M. p. phaeocephalus.—ECUADOR: Manta, 1 ♂; Chongocito, 4 ♂; Chone, 1 ♂, 2 ♀; Bahia, Manaví, 1 ♂; coast of Manaví, 1 ♂, 1 ♀; Isla Puna, 2 ♂, 1 (?); Daule, 1 (?); Esmeraldas, 1 (?); Santa Rosa, 1 ♂, 2 ♀, 1 (?); "Ecuador," 2 (?). PERÚ: Chilaco, 1 (?); Paletillas, 1 ♂, 2 ♀.

M. p. toddi.—PERÚ: Palambla, 1 ♂ (type).

M. p. interior.—PERÚ: Huarandosa, 1 ♂, 2 ♀; Perico, 1 ♂ (type), 1 ♀, 2 (?); Charapi, 1 ♂, 1 ♀; Lomo Santo, 2 ♂; Jaen, 1 ♂, 2 ♀; Pucara, 1 ♀; San Ignacio, 1 ♂, 1 ♀.

Myiarchus ferox ferox (Gmelin)

Muscicapa ferox GMELIN, 1789, 'Syst. Nat.,' I (2), p. 934—based primarily on 'Le Tyran de Cayenne,' BRISSON; Cayenne.

Typical *ferox* appears to occupy the entire Amazonian lowland basin from Perú and Ecuador to the mouth of the Amazon, extending well up the Rio Negro and to the three Guianas, and following the eastern coast of Brazil southward to the vicinity of Rio de Janeiro. Throughout this range I can detect no significant differences in a series of nearly two hundred and twenty birds. The general dorsal color is dark in comparison with the other subspecies, with the top of the head a sootier brown. The series includes only one bird from British Guiana which belongs with *ferox* rather than with adjacent forms to the westward. One specimen from Monte Serrat, Serra do Itatiaya, Brazil, also agrees with *ferox* although a "Rio" trade-skin and two birds from La Raiz are closer to *australis!*

A series of eighteen skins from the middle Orinoco and the Caura region of Venezuela is inseparable from *australis* of southernmost Brazil, Bolivia, Paraguay, Uruguay, and Argentina by any positive taxonomic characters, as has been pointed out by Hellmayr [1926, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 177, footnote b]. The cap is sometimes a little darker than in most of the southern *australis* and the bill, so far as may be determined from dried skins, appears to average darker in color, although the field notes on various specimens do not indicate any such difference. There is a distinction in the dates of molt which might be ascribed entirely to the relative positions of the two regions in relation to the equator. The Argentine and other southern examples of the subspecies molt from January to April and are in worn plumage from October to January; the Orinocan population shows the first signs of molt in August, continuing to November, and is in worn condition from April to July.

One additional specimen, labeled as from La Prición, Río Caura, E. André collector, is quite different from the other Caura birds and appears to be a specimen of something else with erroneous data. It agrees with *venezuelensis* in many particulars, including the rufous edges of the tail and the sharp white margins of the tertials, but differs by somewhat paler coloration above and below. I have no specimens of *insulicola* from Tobago, one of André's localities, to which this specimen may be referable. The series of *venezuelensis* at hand is too small to allow me to say that the Caura example is not merely a pale example of that subspecies.

Birds from the region of Mt. Duida and the Río Cassiquiare are intermediate between *ferox* and *australis*, being paler than *ferox* and darker than *australis*. In general, they are rather closer to *ferox*. On the other hand, four specimens from Villavicencio, Colombia, on an affluent of the Orinoco, although also intermediate between *ferox* and *australis* are closer to *australis*. Three birds from La Morelia, in southeastern Colombia, on an affluent of the Amazon, are typical *ferox*. North, central, and western Colombian birds are *panamensis*.

I am puzzled by a single specimen of *panamensis* from El Zapotal, western Costa Rica, whence I have also a skin of *actiosus*. *M. f. panamensis* has never been recorded from Costa Rica where even *actiosus* is thought to be rare. Until further evidence is available, *panamensis* probably should be considered as a straggler north of Panamá. Nevertheless, the situation deserves further investigation.

The single molting season of typical *ferox* varies considerably according to locality. The relative position, north or south of the equator, appears to have little to do with this variation, in spite of the difference, noted on a preceding page, between the Orinocan and Argentine populations of *australis*. Molting specimens of *ferox* in the collection before me are distributed as follows: Perú and Ecuador—November and December; upper Amazon—January, February, and April; south bank of the lower Amazon—March to August; east coast of Brazil (Bahia, etc.)—April and May; Faro—November to January; Rio Negro—December to February; the Guianas—December to March; Mt. Duida region—October. The birds of the south bank of the lower Amazon stand rather exactly between the northern and southern populations of *australis*, but the Rio Negro series is in closer agreement with birds from Faro, Guiana, the upper Amazon, Perú, and Ecuador.

Records of *ferox* from Perú are from Pebas, Yurimaguas, Chamicuros, Rioja, Jeberos, Santa Cruz, "Upper Ucayali" [= near Cashiboya], "Eastern Perú," Río San Miguel, San Ramon, and Chaquimayo.

The four species, *M. ferox*, *M. cephalotes*, *M. phaeocephalus*, and *M. apicalis* are very closely allied and replace each other geographically and, in part, zonally. *M. ferox* is the inhabitant of the Tropical Zone east of the Andes, extending southward into the northern part of the South Temperate Zone in Argentina and adjacent areas, and reaching Trinidad, northwestern Venezuela, and the Santa Marta region of Colombia, extending up the more humid portions of the Río Magdalena, and occupying the humid western coast of Colombia whence it extends into Panamá; the Costa Rican form inhabits a more arid terrain. *M. phaeocephalus* is the representative species of the arid coastal region of Perú and Ecuador, ascending the mountains of northwestern Perú to the semi-arid zone intermediate between the Arid Tropical and the Subtropical zones. In arid portions of the Cauca and Magdalena valleys in Colombia, *M. apicalis* is found. The Subtropical Zone from Venezuela to Bolivia presents a chain of subspecies of *M. cephalotes*.

Nowhere in this entire area do any two of these species occur at the same localities, so far as the material at hand shows (Chapman's record of *cephalotes* from Zamora, Ecuador, is based on a specimen of *ferox*). Some of the localities are very close together, but always there is an ecological or zonal difference in evidence. The specific distinctions tend to break down to a limited extent as is shown by the sharper tertial margins in *M. f. venezuelensis* (suggesting *cephalotes*), the reduction of whitish on the outer web of the outer rectrices in *M. c. cephalotes* (suggesting *ferox*), the increase of whitish at the tips of the rectrices in *M. c. caribbaeus* (suggesting *apicalis*), and similar minor characters. Nevertheless, each group is rather well defined and in possession of distinctive zonal or ecological niches and specific recognition may be accorded to each of the four groups so long as their probable phylogenetic relationship is not obliterated.

Specimens Examined

M. f. ferox.—French Guiana: Roche Marie, 1 ♂, 1 ♀; Approuague, 4 ♂, 1 ♀; Mana, 1 ♂; Cayenne, 3 ♂, 1 ♀. Dutch Guiana: near Paramaribo, 3 ♂, 2 ♀. British Guiana: Rockstone, 1 ♀. Brazil: Faro, 6 ♂, 8 ♀, 1 (?); Rio Negro, Mt. Curycuryari, 1 ♂; Tauapessasu, 1 ♂, 1 ♀; Santa Maria, 1 ♂; Yucabi, 2 ♀; Santa Isabel, 1 ♂, 1 ♀; Yavanari, 1 ♂, 1 ♀; Igarapé Cacao Pereira, 11 ♂, 9 ♀; Muirapinima, 13 ♂, 3 ♀; Campos Salles, Manaos, 1 ♂; Hacienda Rio Negro, Manaos, 2 ♂; Rio Branco, Caracarahy, 1 ♂; Pará, Flor de Prado, 1 ♀; Rio Tocantins, Baião, 2 ♂, 1 ♀; Mocajuba, 1 ♀; Rio Xingú, Tapará, 4 ♂, 1 ♀; Villarinho de Monte, 1 ♂; Porto de Moz, 1 ♀; Rio Tapajoz, Aramanay, 3 ♂, 3 ♀; Igarapé Brabo, 1 ♂, 2 ♀; Villa Bella Imperatríz, Santa Clara, 4 ♂, 3 ♀; Lago Andirá, 1 ♂, 3 ♀; Boca Rio Andirá, 1 ♀, (1 ?); Rio Madeira, Borba, 3 ♂, 8 ♀; Igarapé Auará, 2 ♂, 3 ♀; Santo Antonio de Guajará, 2 ♂, 3 ♀; Rosarinho, 6 ♂, 3 ♀; Lago Miguel, 2 ♂, 3 ♀; Lago Sampaio, 5 ♂, 4 ♀, 1 (?); Calamá, 1 ♀; Teffé, Boca Lago, 1 ♂, 3 ♀; San Isidro, 1 ♂; Maranhão; Isla São Luiz, Estiva, 1 (?); Isla São Luiz, São José, 1 ♂, 1 ♀; Tabocas, 1 [♀ ?]; Espirito Santo, Santa Barbara de Caparao, 3 ♂; Lagôa Juparaná, 1 ♀, 1 (?); Pernambuco, Brejao, 1 (?); Palmares, 1 ♀; Bahia, Jequié, 1 ♀; Santa Rita, 1 ♂; Barra, 1 ♂; Orobó, 1 (?); Cajazeiras, 1 ♀; Bahia, 2 ♂, 1 ♀, 2 (?); Rio de Janeiro, Serra do Itatiaya, Monte Serrat, 1 ♂. Perú: Puerto Indiana, 1 ♀; Río Seco, west of Moyobamba, 1 ♂, 1 ♀; Rio Negro, 1 ♂; Tocache, 1 (?); Sarayacu, 3 ♂; Santa Rosa, Río Ucayali, 4 ♀; Candamo, 1 ♂; mouth of Río Urubamba, 1 ♂. Ecuador: Zamora, 1 ♀; mouth of Río Curaray, 4 ♂, 3 ♀. Colombia: La Morelia, 2 ♂, 1 ♀.

M. f. ferox (× *australis*).—Venezuela: Río Cunucunumá, Boca de Sina, 2 ♀; Mt. Duida, Esmeralda, 2 ♂, 2 ♀; Río Orinoco, La Laja, 3 ♂, 3 ♀; mouth of Río Ocamo, 3 ♂; opposite mouth of Ocamo, 1 ♀; Río Cassiquiare, El Merey, 1 ♂, 2 ♀, 1 (?).

M. f. australis.—Brazil: Minas Geraës, east of Bôa Espera, 1 (?); Rio Caparao, 1 ♀, 2 (?); Paraná, Porto Britannia, 1 ♂; Guayra, 1 (?); Piauhy, Patos, Gilbues, 1 ♂, 1 (?); Therezina, 1 ♂; São Paulo, Fazenda Cayoá, 1 ♂, 1 ♀; São Sebastião, 1 ♀; Itapura, 1 ♂; Franca, 1 (?); Rio de Janeiro, La Raiz, 1 ♂, 1 ♀; "Rio," 1 (?); Matto Grosso, Campanario, 1 ♂, 1 ♀; Rio Amambary, 1 ♂; Chapada, 10 ♂, 5 ♀, 1 (?); Descalvados, 1 ♂, 1 ♀; São Lorenzo River, 2 ♂; Tapirapoan, 1 ♂; Agua Blanca de Corumbá, 1 ♀; "Brazil," 1 (?). Paraguay: Sapucay, 1 ♂; Puerto Pinasco, 1 ♂; Villarica, 1 ♀. Bolivia: Tres Arroyos, 1 ♂; Todos Santos, 1 ♂, 3 ♀; Province of Sara, 1 ♀. Venezuela: Río Orinoco, Altagracia, 2 ♂.

1 ♀; Perico, 1 ♂; Caicara, 1 ♂, 1 ♀; Maripa, 1 ♂, 1 ♀; Ciudad Bolívar, 1 ♂; Sacupana, 1 (?); mouth of Río Chanaro, 2 (?); Río Caura, La Unión, 1 ♂; La Prición, 1 (?); Mato River, 1 ♂; Río Orinoco, 1 ♂. COLOMBIA: Villavicencio, 1 ♂, 3 ♀.

M. f. venezuelensis.—VENEZUELA: (no exact locality), 1 (?) (type); Puerto La Cruz, 1 ♂; Las Trincheras, 1 ♂.

M. f. subsp.?—"VENEZUELA: La Prición," 1 ♀.

M. f. panamensis.—COLOMBIA: Bagado, 1 ♀; Tumaco, 2 ♀; Chicoral, 1 ♀; Puerto Berrio, 1 ♂, 1 ♀; Malena, 1 (?); Turbaco, 1 ♀; "Bogotá," 2 (?); Santa Marta, 1 ♂, 1 ♀; Donama, 1 ♂, 1 ♀; Buritaca, 1 ♂, 1 ♀; Bonda, 3 ♂, 7 (?). PANAMÁ: [Lion Hill ?], 4 ♂ (incl. type), 1 ♀; La Chorrera, 1 ♀; Savanna near Panamá, 3 ♂, 2 ♀; Monte Oscuro, 1 ♂, 1 ♀; Barro Colorado Island, 1 ♀; Boquete, 1 ♂, 1 ♀; Bogava, 1 ♀; Cape Mala, Cerro Largo, 1 ♂, 1 ♀; El Villano, 3 ♀; Agua Dulce, 1 ♀; Santa Fé, Veraguas, 5 ♂, 3 ♀; Cocoplum, 1 ♂, 1 ♀; Cerro Flores, 1 ♂; Coiba Island, 3 ♂; Pearl Islands, 1 ♀; Brava Island, 1 ♂, 3 ♀. COSTA RICA: El Zapotal, Guanacaste, 1 ♂.

M. f. actiosus.—COSTA RICA: Punta Piedra, 7 ♂, 5 ♀; El Zapotal, 1 ♂.

Myiarchus cephalotes cephalotes Taczanowski

Myiarchus cephalotes TACZANOWSKI, 1879, P. Z. S. London, p. 671—Tambillo, Perú; ♂; type formerly in Warsaw Mus., now lost.

Specimens from most of the Peruvian range of this species, excepting the extreme southeastern portion of the country, are fairly uniform. The throat is moderately pale grayish but not whitish, although there are some streaks of white on the edges of some of the gular feathers. The back is dark grayish olive-brown and the top of the head is decidedly darker and browner. The outer web of the outer tail-feathers is pale in comparison to the adjacent inner web but it is far from clear whitish or yellowish except along the outer margin which is separated from the shaft by a distinctly darker stripe. The pale margin usually is quite narrow; in one or two examples it is wider than the dark stripe, but it never reaches the shaft.

Ecuadorian specimens are in agreement with these characters and are, therefore, referable to typical *cephalotes*. Bolivian birds appear to be different and specimens from extreme southeastern Perú agree with them as described below. Colombian specimens are still different and deserve recognition as a separable subspecies, also described below.

Three young males from Chaupe, Perú, are much like the adults of both sexes in general aspects but differ in many details. The upper parts are decidedly warmer in tone, the margins of the secondaries are light cinnamon-brown instead of yellowish olive, although the edges of the tertials are still whitish; the wing-bars also are strongly cinnamomeous toward the carpal border, much paler toward the inner end; the lesser upper wing-coverts are tipped with cinnamon; the inner margins of the remiges are pinkish buff rather than yellowish; the outer margins of the rectrices are rufous brown except on the outermost pair where the pattern of the adult is present with some modifications (two of the birds have a fine, dusky line separating the clear yellowish outer border from the dull shaft-stripe); the entire under parts are duller than in the adults and the tips of the longest under tail-coverts are tinged with cinnamon.

Peruvian records which probably belong to typical *cephalòtes* are from Tambillo, Tabaconas, Tamiapampa, Chirimoto, Paltaypampa (Junín), Ropaybamba, La Merced, Garita del Sol, and Huachipa.

Myiarchus cephalotes caucae, new subspecies

TYPE from Santa Elena, Antioquia, Colombia; altitude, 9000 feet. No. 133,794, American Museum of Natural History. Adult male collected November 17, 1914, by L. E. Miller and Howarth Boyle.

DIAGNOSIS.—Similar to *M. c. cephalotes* of northern Perú but averaging a little lighter colored on the upper parts and less deeply yellow on the belly and with the outer web of the outermost rectrices more completely whitish or pale yellowish; bill averaging larger.

RANGE.—Central Colombia in the Subtropical Zone of the Central Andes east of the middle stretches of the Cauca River but spreading in the south to the Western Andes and the headwaters of the Río Magdalena.

DESCRIPTION OF TYPE.—Top of head Brownish Olive × Dark Olive with moderately inconspicuous shaft streaks of sooty brown; back Olive × Dark Olive, becoming slightly paler on the rump; upper tail-coverts browner with somewhat paler margins. Lores dull grayish, continuous with the color of the malar region; auriculars a little darker than the back and anteriorly tinged with gray; breast Pale Neutral Gray with chin and throat very little paler; belly Primrose Yellow × Reed Yellow; under tail-coverts paler, nearer Primrose Yellow. Wings blackish brown; secondaries with narrow outer margins of Pale Yellowish Olive, brighter and broader on the inner feathers where also the margins tend to round the tips; tertials with outer margins still broader and paler, Marguerite Yellow, sharply defined; inner margins of remiges yellowish white, sharply defined; under wing-coverts like the belly; greater and median upper wing-coverts blackish brown with broad tips of Olive-Buff and with fine outer margins of the same color on the greater series; lesser series much like the back, some lower feathers with slightly paler tips. Tail Fuscous-Black with faintly lighter tips; outer web of outermost rectrices largely pale yellow, the color reaching the shaft on the subterminal half of the feather (with some indistinct darker barring but no complete separation of margin and shaft by a continuous shaft-stripe as in *cephalotes cephalotes;* terminal tenth and basal third of outer web tinged with pale brownish except on outer margin but not as dark as the inner web. Bill (in dried skin) black, feet blackish brown. Wing, 90 mm.; tail, 90; exposed culmen, 17; culmen from base, 22; tarsus, 20.5.

REMARKS.—Female similar to the male but slightly smaller. Wing, 86–87.5 (♂, 90–97.5); tail, 83–87 (♂, 90–95).

An occasional specimen has the dark area near the tip of the outer web of the outer rectrices about as dark as the adjacent area of the inner web. At the other extreme, the dark area on the basal portion of the web may be nearly obsolete. No specimen of the Colombian series has the strong, dark line separating the yellow margin from the shaft which is present in the Peruvian birds.

The dorsal coloration of *caucae* is not constant and various Colombian specimens are indistinguishable, on this character, from Peruvian specimens of *cephalotes*. The outer web of the outer tail feathers shows the most constant distinction between the two forms. One specimen from east of Palmira, Colombia, has this outer web a little darker than usual, agreeing with several of the Peruvian birds but still distinguishable from most of the series of typical *cephalotes*. In the other Colombian birds examined, there is a positive and recognizable difference, and the most strongly marked specimens from this region have the outer web of the outermost rectrices as sharply pale as in *caribbaeus*, although they differ from *caribbaeus* in other respects such as the less whitish throat and average narrower whitish edges of the tertials.

Myiarchus cephalotes gularis, new subspecies

TYPE from Locotal, Province of Cochabamba, Bolivia; altitude 5800 feet. No. 137,660, American Museum of Natural History. Adult male collected May 30, 1915, by L. E. Miller and Howarth Boyle.

DIAGNOSIS.—Similar to *M. c. cephalotes* of central and northern Perú but with the breast paler gray and the throat noticeably whiter, the upper parts averaging paler and more olivaceous, and the outer web of the outer rectrices (in dorsal aspect) averaging more broadly whitish or yellowish. Compared wth *C. c. caucae* of Colombia, the characters are as given above except that the outer web of the outer rectrices averages less broadly pale. Compared with *C. c. caribbaeus* of Venezuela, the upper and under parts are very similar but in *caribbaeus* the outer web of the outer rectrices is more consistently pale (even in comparison with *caucae*) and clearer white, the outer margins of the tertials are distinctly broader and whiter, and the wing-bars are stronger.

RANGE.—Subtropical Zone of northern Bolivia in the Departments of Santa Cruz, Cochabamba, and La Paz, extending westward into extreme southeastern Perú.

DESCRIPTION OF TYPE.—Top of head somewhat warmer than Brownish Olive, with darker shaft-stripes; back lighter than Dark Greenish Olive; upper tail-coverts brown with brighter margins. Lores whitish or pale grayish; malar region similar; auriculars darker gray; chin and throat distinctly whitish, passing into Pallid Neutral Gray on the breast; belly and under tail-coverts Barium Yellow. Wings sooty brown; secondaries with narrow outer margins dull yellowish; tertials with margins a little wider and more whitish; upper wing-coverts blackish brown; greater series with narrow outer margins Olive-Buff; median series with tips rather broadly dull Olive-Buff; lesser series with rather inconspicuous pale tips only on the lower feathers; under wing-coverts like the belly, with a dark area near the base of the primaries; inner margins of the remiges dull whitish or pale yellowish. Tail Fuscous with brownish olive outer margins except on outermost pair which (in dorsal aspect) have the outer web pale brownish adjoining the shaft but with a narrower outer margin of clear light yellow, not reaching the tip nor the base of the feather. In ventral aspect, the outer web of the outer feather appears more uniformly pale than in dorsal aspect. Bill (in dried skin) blackish; feet blackish. Wing, 91 mm.; tail, 88; exposed culmen, 15.25; culmen from base, 21; tarsus, 20.5.

Remarks.—Females similar to the males in color but somewhat smaller. Wing, 85–87 (♂, 89.5–91); tail, 81–87 (♂, 87–88). One bird without given sex has the wing 92; tail, 90. It is probably a male and of maximum size. One bird sexed as a male has the wing 86; tail, 82.5. Its measurements agree with those of the other birds sexed as females and I judge it to be wrongly sexed.

Two specimens are at hand from southeastern Perú, a male from Santo Domingo and a female from Oroya. The female is an unquestioned *gularis;* the male is not quite so well marked. Association with *gularis* rather than with *cephalotes* is probable also on geographic grounds. There are no additional records from this part of Perú. No records exist from the area between the Inambari Valley and the Junín and Chanchamayo regions, although the species is likely to be found somewhere in the intervening mountains. Hellmayr's record of the species from Chaquimayo and Chapman's record from Río San Miguel have both been transferred by Hellmayr (1927) to *M. f. ferox.*

It is interesting to note that in this species, as in various other birds, the existing peripheral forms, *gularis* and *caribbaeus,* from Bolivia and Venezuela, respectively, are similar in many respects by which they differ from the intervening subspecies.

Specimens Examined

M. c. cephalotes.—Perú: Chachapoyas, 2 ♂; San Pedro, 1 ♂; Molinopampa, 1 ♀[1]; Uchco, 1 ♂[1]; Levanto, 1 ♂; Nuevo Loreto, 1 [♀ ?]; Vista Alegre, 1 ♂[1]; Chinchao, 4 ♂[1], 2 ♀[1]; Chaupe, 6 ♂, 2 ♀; Utcuyacu, 2 ♂, 2 ♀; Rumicruz, 1 ♂, 1 ♀; Chelpes, 1 ♂, 1 ♀, 1 (?); Garita del Sol, 1 ♂. Ecuador: Loja, 1 ♀; Archidona, 1 ♂; Baños, 1 (?); Baeza, 2 ♂, 1 ♀; upper Sumaco, 1 ♀; Río Oyacachi, 1 ♂.

M. c. gularis.—Bolivia: Locotal, 1 ♂ (type), 2 ♀; Vermejo, 1 ♂, 1 ♀; Roquefalda, 1 ♀; Mapiri, 1 [♂ ?]; Yungas, 1 [♀ ?]; Pitiguaya, 1 "♂" [= ♀ ?], 1 [♀ ?]. Perú: Santo Domingo, 1 ♂; Oroya, Río Inambari, 1 ♀.

M. c. caucae.—Colombia: Santa Elena, 1 ♂ (type), 1 ♀, 1 [♂ ?]; La Candela,

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[1] Specimens in Field Museum of Natural History, Chicago.

1 ♀; east of Palmira, 1 ♂, 2 ♀; above Salento, 1 ♂; Salento, 1 ♀; El Eden, 1 ♂; "Cauca Valley," 1 ♂; "Bogotá," 1 [♀ ?]; Río Toche, 1 ♂.

M. c. caribbaeus.—VENEZUELA: Carapás, 1 ♂; Galipán, 2 ♂, 3 ♀; Loma Redonda, 1 ♂; Maracay, Aragua, 1 (?).

Myiarchus tuberculifer tuberculifer (D'Orbigny and Lafresnaye)

T[yrannus] tuberculifer D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., cl. 2, "Syn. Av.," p. 43—Guarayos, Bolivia; Paris Mus.

Myiarchus gracilirostris PELZELN, 1868, 'Orn. Bras.,' II, p. 183—Villa Maria (= São Luiz de Caceres), Matto Grosso, Brazil; Vienna Mus.

Myiarchus coalei RIDGWAY, 1887, Proc. U. S. Nat. Mus., IX, p. 520—Orinoco Valley; U. S. Nat. Mus.

The range of the typical form in Perú is confined to the Humid Tropical Zone. I have specimens from the junction of the Urubamba and Ucayali rivers, from "Chanchamayo," and from Río Seco, west of Moyobamba, all high up in the Tropical Zone. At only a little higher elevation, in the Subtropical Zone, the related form *atriceps* is found. A discussion of the relationship will be given under *atriceps*.

Except for some of the specimens listed among the material examined, the only records of typical *tuberculifer* from Perú are from Iquitos.

The series of *tuberculifer* shows some definite differences in different parts of the range that may be taxonomically important. The birds from northern Bolivia, eastern Perú, eastern Ecuador, the upper Amazon, the Rio Negro (Brazil), and the region near Mt. Duida (Venezuela) are rather uniformly dark olive on the back and rather dark gray on the chest, with the top of the head sooty brown. Skins from the northern coast of Venezuela and the Santa Marta region of Colombia are, for the most part, distinctly paler and more greenish on the back, with the top of the head slightly paler and the chest whiter; the outer margins of the secondaries, furthermore, often show a decided cinnamomeous cast which is not certainly due to immaturity since various immature specimens are recognizably distinct in various particulars. Unfortunately, the available north-Venezuelan and Santa Martan skins are mostly considerably older than the dark Amazonian specimens. A few fresher birds from the mountains behind Cumaná are darker than the other north-coastal birds while, in contrast, an old Peruvian bird is brighter than most Venezuelan skins. This Peruvian bird (from "Chanchamayo") is very like lower Amazonian skins and may be a mislabeled skin of the new form described hereunder. On the other hand, Trinidad birds are quite comparable to the dark Peruvian-Bolivian specimens. Orinocan skins, of moderate age, are somewhat intermediate between the two extremes. The name, *coalei*, based on an "Orinoco-skin," might be available for a separable form in the northern region, if positive distinction can be established. A good series of fresh specimens from Santa Marta, the Orinoco, and the north-coast of Venezuela will be needed to establish such distinction.

I am unable to refer lower Amazonian birds to *tuberculifer* or to *tricolor* and describe a new form, as follows.

Myiarchus tuberculifer clarus, new subspecies

TYPE from Tapará, Rio Xingú, Brazil. No. 429,772, American Museum of Natural History. Adult female collected August 23, 1931, by Alfonso M. Olalla.

DIAGNOSIS.—Similar to *M. t. tuberculifer* of northern Bolivia but with the top of the head paler, less contrasting with the back, by reason of duller centers and more olivaceous margins on the feathers. Back rather brighter olive than in typical *tuberculifer.*

RANGE.—Both banks of the lower Amazon and adjacent parts of the tributaries, at least on the Tapajoz, Xingú, and Jamundá rivers, extending northward to Dutch (and, presumably, French) Guiana.

DESCRIPTION OF TYPE.—Back between Citrine-Drab and dark Kronberg's Green, with dusky central areas exposed when the feathers are disarranged; top of the head Dark Olive with the feathers edged and tipped with brighter olive, especially over the eyes where the general color is much like that of the back; lores light gray; auriculars dull brownish; upper tail-coverts tinged on the margins with a slight brownish hue. Chin and throat pale gray, with somewhat whitish streaks; breast slightly darker, near Pallid Neutral Gray; lower under parts Barium Yellow; sides of breast near the color of the back. Wings sooty brown; primaries only faintly edged exteriorly with paler; secondaries more broadly margined with yellow; tertials still more prominently margined with light yellow; under wing-coverts Naphthalene Yellow; inner margins of remiges dull whitish. Tail dark brown with faintly paler terminal area, not conspicuous; outer margins dull Citrine-Drab, broadest basally, but outermost rectrix with a narrower, sharper, and more yellowish marginal line. Bill, in dried skin, blackish brown; feet black. Wing, 78.5 mm.; tail, 70.25; exposed culmen, 14.25; culmen from base, 18.25; tarsus, 17.5.

REMARKS.—Males similar to the females in color but averaging larger.

In discussing *M. t. tricolor*, Todd (1922, Proc. Biol. Soc. Wash., XXXV, pp. 211–212) was handicapped by lack of specimens from any locality nearer the type-locality (Rio de Janeiro) than the Pará district. I have three skins from the state of Espirito Santo and two from that of Bahia, and these are quite unlike specimens from the lower Amazon. They have the top of the head fully as dark as does *tuberculifer* from which they differ very slightly; the pectoral region is paler gray (as in *clarus*) and the size is slightly smaller than that of *tuberculifer* (wing: ♂, 77.25–78 mm.; ♀, 69–71.75).

I have only a single specimen from the Pará district and it is so badly abraded that its distinctive characters are lost. Hellmayr [1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 191, footnote b] notes that the types of *tricolor* and several skins from Bahia are smaller and paler below than a series from Maranhão and Pará. The Pará skin now before me is nearly as small (wing, 72 mm.) as that of the Espirito Santo and Bahia birds and the top of the head appears to be darker than in the lower Amazonian series. I am unable, therefore, to say with any certainty that the Pará population belongs either to *tricolor* or to *clarus*, although the single specimen now at hand is very like *tricolor*.

I have only two specimens from Dutch Guiana. One of these is very like the lower Amazonian birds; the other might be referred to *tuberculifer*, to which a British Guianan skin more certainly belongs.

The Peruvian skin from "Chanchamayo," mentioned in the discussion of *tuberculifer*, is a close match for some of the specimens of *clarus* and is totally unlike any other Peruvian bird examined. It would not be surprising to find that it is wrongly labeled as to locality although it may be an unusual individual variant of the typical form. It does not agree with old and faded skins of true *tuberculifer* from other localities nor with the north-Venezuelan examples discussed under that form.

The arrangement of the Central American forms also is far from satisfactory. It appears probable that *olivascens* does not breed south of Durango and Sinaloa, Mexico, and that examples from south of this range are but wintering individuals in the range of *querulus*. A January specimen from Escuinapa is marked: "arrives in October"; and April birds from Río Sestin, Durango, are marked: "arrives in April, breeds in May."

The highland form in Guatemala, as stated by Miller and Griscom, is *lawrenceii* of eastern Mexico. At lower elevations in Guatemala is *connectens*, differing from *lawrenceii* only by smaller size. Its type locality is in the highlands of Nicaragua, in the Caribbean drainage. Birds from the Pacific lowlands of Nicaragua are rather different, averaging definitely paler above than typical *connectens*, although one specimen from near the type locality of *connectens* is nearly as pale. Skins from the Pacific region of northwestern Costa Rica also are of this pale nature and there is a suggestion of the same tendency (far from uniformly) in a few examples of *connectens* from the Pacific slopes of Guatemala. Furthermore, certain birds from near San José and Cartago, Costa Rica, are intermediate between this pale variant and *nigricapillus* which, in turn, is intermediate between them and the still darker *bangsi* of western Panamá. Unless a pale subspecies be recognized, these western birds perhaps should be referred to *nigricapillus* which they resemble rather more than they do *connectens.*

There are no sharp lines between any of these forms, although average specimens are easily recognizable; extremes in one direction or another are likely to be confused with an adjacent form.

Farther south, *brunneiceps* of eastern Panamá appears to range through most of central and western Colombia. Birds from this Colombian region have been referred heretofore to *nigriceps* toward which, in fact, they show some tendencies. True *nigriceps,* however, has a very black cap while the Colombian birds do not, agreeing in the brownish hue of that area with the east-Panamanian birds. The back of the Colombian specimens is not always so clear green as in the type and some other Panamanian specimens of *brunneiceps* but sometimes it is equally so; sometimes it approaches *nigriceps* in grayish tone. Three skins from Andalucia and one Bogotá trade-skin show the only strong suggestions of the black cap of *nigriceps.*

Myiarchus tuberculifer atriceps Cabanis

Myiarchus atriceps Cabanis, 1883, Jour. für Orn., XXXI, p. 215—San Xavier, Tucumán, Argentina; cotypes in Berlin Mus.?

Birds from Argentina, Bolivia, and southeastern Perú, from the Junín region southeastward, show the maximum measurements of the Andean populations (wing: ♂, 89–94 mm.; ♀, 82.5–88.5). Northward in Perú there is some reduction in size (wing: ♂, 84–90; ♀, 78.5–86). The west-Ecuadorian *nigriceps* is still smaller (wing: ♂, 72–83 in northern examples, increasing to 79–86 in the southern part of the country). So exact is the overlap that it is impossible to draw a definite line of distinction. The cañon of the Río Marañón and the crest of the Western Andes are equally unsatisfactory as boundary lines and if the specimens are arranged on either such basis, the overlap in measurements is emphasized. The least difficulty appears when *atriceps* is restricted (in the north) to Perú and *nigriceps* to Ecuador. Thus *nigriceps* crosses the Andes to the eastern side on the upper waters of the Río Zamora and also reaches the Alamor Range near the boundary between Perú and Ecuador. On the other hand, *atriceps* crosses the Marañón to the eastern side of the western Andes and also, in a limited area, crosses the Andes to their western side.

This arrangement leaves *atriceps* with a wing measurement in the males of 84–94 mm.; females, 78.5–88.5. The males of *nigriceps* then have the wing 72–86 mm.; females, 71–80.

Specimens from the upper Río Zamora in eastern Ecuador (Zamora, Sabanilla, and Guayaba) and one from San Ignacio, Perú, all show some trend toward typical *tuberculifer* in respect to the color of the top of the head. This area in the specimens mentioned is not so deep black as usual but has a slight brownish tinge, particularly pronounced in the San Ignacio bird. When compared with examples of *tuberculifer* from farther east in Perú and Ecuador, the birds in question show closer resemblance to *atriceps* and *nigriceps* to which, respectively, I have referred them.

Two birds from Roquefalda, Cochabamba, Bolivia, agree with *atriceps* in the clear greenish color of the back and, furthermore, have the top of the head rather strongly blackish though not so deep black as *atriceps*. In size, however, they are small. The only adult, a female, has the wing only 76 mm., in agreement with the females of *tuberculifer* but much less than the females of *atriceps* from the nearby highlands although females from the northernmost part of the range of *atriceps* are nearly as small. Actually, these Roquefalda birds match rather closely the specimens from the Río Zamora and San Ignacio which I have referred to *atriceps* and *nigriceps*, respectively. Roquefalda appears to be at a high elevation, probably in the Subtropical Zone, and the two specimens in question may, therefore, be small and dull examples of *atriceps* rather than the other extreme of *tuberculifer*. The important point is that there is evident intergradation at points of contact between the ranges of the Tropical Zone and Subtropical Zone forms and these forms must be considered as zonal, as well as geographical, representatives of the same species.

It is probable that *atriceps* is rather strictly an inhabitant of the Subtropical Zone, although it reaches the lower limits of that zone. The Ecuadorian *nigriceps* appears to invade the Tropical Zone to a limited extent, although it, also, is primarily a Subtropical Zone bird. In Colombia, *brunneiceps* is largely confined to the Tropical Zone but, as noted on an earlier page, birds from Andalucia, in the Subtropical Zone, show noticeable intermediacy between *brunneiceps* and *nigriceps* although they are best referable to *brunneiceps*.

Earlier records from Perú which must belong to *atriceps* are from Tambillo, Cutervo, Callacate, Huambo, Tamiapampa, Malca, Paucal, Tabaconas, "Huayabamba" [= above Huambo, 5400 feet], Paltaypampa, Pumamarca, Maraynioc, Torontoy, Huaynapata, and Cachupata.

Specimens Examined

M. t. tuberculifer.—Bolivia: Mission San Antonio, 1 ♀; mouth of Río San Antonio, 1 ♂; Roquefalda, 1 ♂, 1 ♀. Perú: Lagarto, 1 ♂, 1 ♀; Río Colorado, 1 ♂[1]; "Chanchamayo, 1 ♂"[2]; Puerto Indiana, 1 ♂, 1 ♀; Río Seco, west of Moyobamba, 2 ♂. Ecuador: mouth of Río Curaray, 2 ♂; lower Río Suno, 1 ♀. Colombia: Buena Vista, 1 ♀, 1 (?); "Bogotá," 3 (?); Santa Marta, Cacagualito, 1 ♂, 3 ♀; Onaca, 2 [♂ ?], 1 [♀ ?]; Las Nubes, 1 ♀; Minca, 2 ♂, 4 ♀, 3 [♀ ?]; Valparaiso, 3 [♀ ?]. Venezuela: Mérida, 2 ♀, 2 (?); Escorial, 1 ♀; El Valle, 1 ♂; Culata, 1 ♂, 1 ♀; San Antonio, Bermúdez, 2 ♂; Cristóbal Colón, 1 ♀; Las Trincheras, 1 ♂, 1 ♀; El Guácharo, 1 ♂; Quebrada Seca, 2 ♂, 1 ♀; La Tigrera, 2 ♂, 1 ♀; Los Dos Ríos, 1 ♂; Santa Ana Valley, 1 ♂; Campos Alegre Valley, 1 ♂, 1 ♀; Caripé, 2 (?); Loma Redonda, 1 ♂; La Latal, 1 ♂, 1 ♀; Río Neveri, 1 ♀; Caicara, 1 ♂, 1 ♀; Nericagua, 2 ♀; Quiribana de Caicara, 1 ♂, 1 ♀; Ayacucho, 1 ♀; mouth of Río Ocamo, 1 ♂, 1 ♀; Río Cassiquiare, El Merey, 2 ♀. Trinidad: Aripo, 1 ♂; Caparo, 1 ♂, 2 ♀; Princestown, 1 ♀. British Guiana: Carimang, 1 ♂. Brazil: Rio Negro, Muirapinima, 1 ♀; Rio Branco, Serra Grande, 1 ♂[1]; Rio Madeira, Igarapé Auará, 1 ♂, 1 ♀; Rosarinho, 3 ♂; Marmellos, 1 ♂.

M. t. tricolor.—Brazil: Espirito Santo, Lagôa Juparaná, 1 ♂, 2 ♀; Bahia, Bôa Nova, 1 ♂, 1 ♀.

M. t. clarus.—Brazil: Rio Xingú, Tapará, 1 ♀ (type); Rio Tapajoz, Caxiricatuba, 1 ♀; Igarapé Amorin, 1 ♂; Igarapé Brabo, 1 ♂; Rio Amazonas, Villa Bella Imperatríz, 2 ♀; Rio Jamundá, Faro, 2 ♀. Dutch Guiana: near Paramaribo, 2 ♀.

M. tuberculifer subsp.?—Brazil: Pará, Igarapé Assu, 1 ♀.

M. t. atriceps.—Argentina: Tucumán, 1 ♂; above San Pablo, 1 ♂. Bolivia: Mizque, 1 ♂. Perú: Limbani, 1 ♂; Inca Mine, 1 ♂; Santo Domingo, 5 ♀; Chelpes, 3 ♂, 2 ♀; Panao, 1 ♀[1]; Chinchao, 1 ♀[1]; Huánuco, 4 ♂[1], 4 ♀[1]; Huachipa, 1 ♂[1]; Hacienda Llagueda, 1 ♂[1]; Hacienda Limón, 1 ♂[1]; Lomo Santo, 1 ♂, 1 ♀; Taulis, 1 ♂, 1 ♀; La Lejia, 1 ♀; San Felipe, 1 ♀; Cajabamba, 1 ♂, 1 ♀; San Ignacio, 1 ♀.

M. t. nigriceps.—Ecuador: Celica, 1 ♂; Sabanilla, 1 ♀; Guayaba, 1 ♂; Zamora, 1 ♂; Salvias, 1 ♀; Portovelo, 1 ♂; Zaruma, 1 (?); Esmeraldas, 1 ♂, 1 ♀; Paramba, 1 ♂, 2 ♀; San Javier, 1 ♂; Chimbo, 1 ♂, 1 ♀; Gualea, 3 ♂; Intag, 2 ♂, 2 ♀; San Nicolas, 1 ♂; Chongon Hills, 1 ♂; Chone, 1 ♂; Coco, 1 ♂; San Bartolo, 1 ♂; Guachanamá, 1 ♀.

M. t. brunneiceps.—Panamá: [near Lion Hill], 1 ♀ (type); Chepigana, 1 (?); Cituro, 1 ♀; Tacarcuna, 1 ♀; east slope of Mt. Tacarcuna, 1 ♀. Colombia: Río Frio, 1 ♀, 1 (?); Dabeiba, 2 ♂; Alto Bonito, 1 ♂, 1 ♀; Cali, 1 ♂; San José, Cauca, 1 ♂, 2 ♀; Juntas de Tamaná, 1 ♂; "Juntas," 1 ♂; Andalucia, 1 ♂, 2 ♀; "Bogotá," 1 (?).

M. t. bangsi.—Panamá: Boquete, 1 ♂, 1 (?); Boqueron, 1 "♀" [= ♂ ?]; Santa Fé, 1 ♂, 7 ♀, 1 [♀ ?]; El Villano, 1 ♂; Cerro Montoso, 1 ♂; Cerro Flores,

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[1] Specimens in Field Museum of Natural History, Chicago.
[2] Not typical.

1 ♂, 2 ♀, 1 (?); Almirante, 2 ♂, 2 ♀; Wilcox Camp, 1 ♀; Chitrá, 1 ♀. Costa Rica: Buenos Aires, 4 ♂, 1 ♀; Volcán de Oso, 2 ♀; Puerto Jiménez, 1 ♀; El Pozo, 5 ♂, 1 ♀.

M. t. nigricapillus.—Costa Rica: (Bonilla, Guayabo, Cartago, Navarro, Navarrito, Limón, San José, Agua Caliente, Las Cañas, Guacimo, Carrillo, Aquinares, San Pedro), 21 ♂, 11 ♀, 1 (?). Nicaragua: San Francisco, San Juan River, 1 ♂.

M. tuberculifer subsp.?—Nicaragua: Tipitapa, 1 ♂; Chinandega, 2 "♂" [= ♀ ?], 1 (?) [= ♂ ?], Volcán de Chinandega, 1 ♀; Volcán Viejo, 2 ♂, 1 ♀; Corinto, 2 ♂, 3 ♀. Costa Rica: Miravalles, 2 ♀; Bebedero, 1 ♀; El Zapotal, 2 ♀.

M. t. connectens.—Nicaragua: Las Cañas, 1 ♂ (type); San Rafael del Norte, 1 "♂" [= ♀ ?], 1 ♂; Matagalpa, 1 ♀, 1 (?); Ocotal, 1 ♀. Honduras: Ceiba, 2 ♂. Guatemala: (Finca Carolina, Secanquim, Finca Sepacuite, Hacienda California, Finca Cipres, Finca Chamá, Finca Concepción, Chipoc, Chimoxan, Pantaleon, Vera Paz, Puebla, Finca La Primavera, Chalachi, San Felipe, "Guatemala"), 47 ♂, 34 ♀, 15 (?).

M. t. lawrenceii.—Guatemala: (Huehuetenango, San Lucas, Nebaj, Panajachel, Lake Amatitlan, Antigua, Sacapulas, San Antonio), 12 ♂, 13 ♀, 2 (?). Mexico: (Jalapa, Mexico City, Boque Negro, Montemorelos, Boquilla, Victoria, Río Pilón, Tlacotalpan), 20 ♂, 7 ♀.

M. t. olivascens.—Mexico: (Juan Lisiarraga Mts., Escuinapa, Los Pieles, San Blas, Río Sestin, Barranca de Cobre), 10 ♂, 5 ♀. United States: Fort Huachuca, 1 ♀; Huachuca Mountains, 1 ♂; Santa Rita Mountains, 2 ♂, 2 ♀; Pinal Co [Arizona], 1 ♂.

M. t. querulus.—Mexico: Los Canoas, Colima, 1 ♂; Volcán de Nieve, 1 ♀; Wakenakili Mountains, 1 ♂.

M. t. platyrhynchus.—Mexico: Yucatan, 2 (?); Cozumel Island, Quintana Roo, 1 ♀.

M. t. tresmariae.—Mexico: Tres Marias Islands, Maria Madre, 1 ♂, 3 ♀, 1 (?); Cleofa Island, 1 ♀.

Myiarchus semirufus Sclater and Salvin

Myiarchus semirufus Sclater and Salvin, 1878, P. Z. S. London, p. 138, Pl. xi—Pacasmayo, Perú; Steere Coll. (repository unknown to me).

This species has a very restricted range, being confined to the Arid Tropical Zone of northwestern Perú, ascending the western slope of the Western Andes above Trujillo as high as 1500 feet.

This bird stands somewhat apart from the general assemblage of species in the genus *Myiarchus* in which it appears to have no very close relative. The color is predominantly rufous instead of gray and yellow; the plumage is rather coarse in texture; the crest is rather long; the scutellation of the tarsus is a little rougher than usual; the bill is relatively long, somewhat flattened, and convex in lateral outline to near the narrow tip. Nevertheless, except for the color, the characters are not perfectly diagnostic. The tiny tubercle on the under side of the wing at the base of the outer primary is present as in other members of *Myiarchus* (as well as in *Hylonax* and *Eribates*), pointing to close affinity. I believe that *Muscifur* of Bangs and Penard, erected for *semirufus*, is of good subgeneric value but that it is not entitled to full generic rank.

Records of *semirufus* are from Pacasmayo, Sullana, Chepen, Tumbez, Guadalupe, and Chimbote.

SPECIMENS EXAMINED

M. semirufus.—PERÚ: Somate, 3 ♂, 2 ♀; Virú, 3 ♂, 5 ♀; Chilaco, 3 ♂; Pilares, 1 ♂; Chepen, 1 ♂; Trujillo, 1 ♂; Trembladera, 2 ♂, 1 ♀.

Mitrephanes phaeocercus olivaceus Berlepsch and Stolzmann

Mitrephanes olivaceus BERLEPSCH AND STOLZMANN, 1894, Ibis, p. 391—Garita del Sol, Perú; ♂; Warsaw Mus.

There appears to be but a single form in Perú which ranges from the northern part of the country to the southeastern corner, following the Andes and apparently restricted to the upper part of the Humid Tropical Zone.

I have already (1930, Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 378) described the immature plumage of this form which bears a decided resemblance to that of *aurantiiventris*, *nicaraguae*, *quercinus*, *eminulus*, and probably the remaining members of the species *phaeocercus*. There is nothing in the series of juvenal plumages to suggest any specific separation, but rather the contrary; the specific unity of the entire group already has been proposed by Hellmayr.

The adults show a nearly perfect transition between the most nearly uniform brownish pattern, in typical *phaeocercus* of eastern Mexico, to the most nearly uniform greenish birds, *olivaceus* of Perú, with the development of clearest yellow on the belly about the middle of the row. The upper parts show the transition from brown to green with less interruption. In size, according to the material at hand, *phaeocercus*, *tenuirostris*, and *quercinus* are the largest, *vividus*, *eminulus*, and *berlepschi* the smallest, and *nicaraguae*, *aurantiiventris*, and *olivaceus* intermediate.

The first annual plumage of the various subspecies appears to be recognizably distinct from both the juvenal and adult plumages. The general body plumage is like that of the adult, occasionally slightly duller, while the wings and tail are intermediate. The lesser upper wing-coverts are conspicuously, though narrowly, tipped with cinnamon-buff or pale cinnamon; the two wing-bars are narrow, buffy or cinnamon, often becoming whitish on the inner portion of the lower bar, and very sharply defined; the outer margins of the tertials are more whitish and broader than in the adults. The rectrices are finely tipped with buffy color; the upper tail-coverts are near the color of the back but have fine whitish tips. These markings are all modifications of the juvenal pattern but are paler and finer and might be thought to represent actual juvenal feathers from which the marginal portion of the webs had been worn away and the remaining color faded, thus indicating the post-juvenal molt to be but partial. I am not sure that this is the case, however. The main portion of the webs of the remiges and rectrices is a little blacker in the first annual plumage and, in the greener-backed subspecies, there appears to be a slightly greater approach toward the adult olive color on the outer margins of the rectrices and on the upper tail-coverts. Occasional specimens in fresh condition are even more like the adults with only a trace of the pale, immature markings. It may be added that the type of *vividus* from Panamá is in the first annual plumage.

In Central America there has been considerable differentiation of subspecies. These are not always strongly marked but are recognizable in series, although the ranges of some of them are rather restricted. I am unable to place *Mitrephanes phaeocercus pallidus* Carriker and de Schauensee (1935, Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 435—Guatemala City) satisfactorily in this series. Two specimens at hand from Guatemala City are definitely *quercinus*, having been identified by van Rossem, one of the co-authors of that subspecies, and agreeing with eight other Guatemalan specimens of that form. On the other hand, the description of "*pallidus*" agrees in detail with a specimen of *Empidonax fulvifrons fusciceps* from Guatemala and I suspect that "*pallidus*" is a redescription of that bird. The whitish outer web of the outer rectrices is rather characteristic.[1]

The two Colombian specimens recorded by Chapman (1917, Bull. Amer. Mus. Nat. Hist., XXXVI, p. 472) are more nearly in agreement with the type of *berlepschi* from northern Ecuador than with a small series of *eminulus* from eastern Panamá. The skin from Monquido is very similar to the type of *berlepschi*. The Alto Bonito specimen is not so close, being even less tawny on the breast and brighter and clearer yellow on the belly, and it is thus even farther away from

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[1] Since the above note was written, de Schauensee has published (Auk, 1937, LIV, p. 540) an identical conclusion, based on a reexamination of the type of *pallidus*

eminulus, taxonomically, than typical *berlepschi* although the locality is very close to eastern Panamá. If not representing an undescribed form, this bird must be referred to *berlepschi* as its nearest affine.

A single specimen collected by Dr. Von Patten in some part of Guatemala (the exact locality is not given on the label) is not clearly referable to *phaeocercus*, *tenuirostris*, or *quercinus*. It is most closely matched by a specimen from Zapotlan, Jalisco, Mexico, which, in turn, is intermediate between *phaeocercus* and *tenuirostris*, being paler than the one and darker than the other. Both are in first annual plumage. Jalisco birds have been referred to *tenuirostris*, although Ridgway comments on their intermediate nature, but there have been no indications of *tenuirostris* reaching anywhere near Guatemalan territory. Without some exact locality for this Guatemalan skin, its identity is best left for future determination. Other Guatemalan skins examined, including one from the far northwestern part of the country, belong to *quercinus*.

The type and the specimens of *olivaceus* listed below comprise all the material recorded from Perú.

SPECIMENS EXAMINED

M. p. phaeocercus.—MEXICO: Vera Cruz, Jalapa, 1 ♂, 1 ♀; City of Mexico, 1 ♀; "Mexique," 1 (?).

M. p. tenuirostris.—MEXICO: Tepic, Sierra de Alica, 2 ♂; Chihuahua, "Camp 48," 1 ♂; Jalisco, La Laja, 1 (?); La Pisagua, 1 (?); Zapotlan, 1 ♂.

M. p. subsp.?—GUATEMALA: 1 (?).

M. p. quercinus.—GUATEMALA: Chanquejelve, 1 ♂; Chichicastenango, 1 ♂; Tecpam, 1 ♂, 4 ♀, 1 (?); Guatemala City, 1 ♂, 1 ♀.

M. p. nicaraguae.—NICARAGUA: San Rafael del Norte, 3 ♂ (incl. type), 2 ♀; Ocotal, 3 ♂.

M. p. aurantiiventris.—COSTA RICA: Barranca, 1 (?); Coliblanco, 3 ♂; Dota, 1 ♂; Lagunaria, Santa Maria de Dota, 1 ♀; Estrella de Cartago, 1 ♂, 1 ♀; Azahar de Cartago, 1 ♂, 1 ♀, 1 (?); Carrillo, 1 ♂; La Hondura, 1 ♂, 2 ♀; Navarro, 1 ♂. PANAMÁ: Chiriqui, Boquete, 5 ♂, 1 ♀; "Chiriqui," 1 (?).

M. p. vividus.—PANAMÁ: Veraguas, Chitrá, 4 ♂ (incl. type), 1 ♀.

M. p. eminulus.—PANAMÁ: Mt. Tacarcuna, 4 ♂, 1 (?).

M. p. berlepschi.—COLOMBIA: Monquido, 1 (?); Alto Bonito, 1 ♂ (not typical). ECUADOR: Bulún, 1 ♀ (type).

M. p. olivaceus.—PERÚ: Santo Domingo, 1 ♂, 1 ♀; Inca Mine, 1 ♂, 1 ♀; Idma, 2 ♂; Chelpes, 1 ♂; Huachipa, 2 ♂[1], 1 (?)[1]; Uchco, 1 ♀[1].

Cnemotriccus fuscatus fuscatior (Chapman)

Empidochanes fuscatus fuscatior CHAPMAN, 1926 (Oct. 26), Amer. Mus. Novitates, No. 231, p. 6—junction of Río Curaray and Río Napo [Ecuador]; ♂; Amer. Mus. Nat. Hist.

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[1] Specimens in Field Museum of Natural History, Chicago.

Specimens from the Ucayali River agree well with the average specimen from eastern Ecuador although the type is much the darkest example of any from either region. Similarly, specimens from the south bank of the Amazon, as far east as the Tocantins, are comparable to Ecuadorian birds without reaching the extreme of the type.

Some specimens of *fuscatior* come very close to *fumosus* but, in general, the Ecuadorian form is darker above, with a tendency toward a fuscous hue rather than an olive one, with a stronger pectoral band, duller and less conspicuous wing-bars, and less yellowish under parts. Young birds are paler above, with a rufous tinge, and have the wing-bars brighter and more conspicuous than those of the adults. Some adults are indistinguishable from certain examples of *fumosus*.

Two specimens from Faro, on the north bank of the Amazon, are difficult of assignment. One is unusually dark above and the other is paler, but both have rather prominent wing-bars. The dark one is very like some *fuscatior* but the other may be matched by certain *fumosus*. Geographically they should belong to *fumosus*, to which I assign them tentatively.

A single specimen from Mexiana Island is equally equivocal and may be matched by specimens from the Guianas and others from the south bank of the Amazon. It is paler above than the average of *fuscatior* but more deeply yellow on the belly, with wing-bars of only moderate prominence. For the present I leave it with *fumosus* to which Mexiana birds have been assigned by Hellmayr.

A still more puzzling example is a bird labeled as from the Igarapé Paituna, somewhat east of Faro. It agrees in all particulars, including the small bill and pale mandible, with *bimaculatus* and is beyond any extreme of *fumosus* or *fuscatior* which I have seen. It may possibly be wrongly labeled or it may be a casual migrant from Paraguay or Argentina, although I have no other evidence of migratory tendencies in this species.

The northern subspecies, *cabanisi*, is far from uniform, as has been noted by various authors. Specimens from Colombia, northern Venezuela, and even Monos Island are recognizably distinct from Tobago birds as represented in the series before me, being paler on the upper parts, yellower on the belly, and brighter rufescent on the somewhat broader wing-bars. There is a slight approximation of characters in a very few specimens, especially in those from northeastern Venezuela and Monos Island, even these are not as dull in color as the Tobago specimens. Trinidad examples are said to be of the yellow-bellied sort also, including the types of *cabanisi*. The grayer Tobago birds have been separated by Ridgway as *vireoninus*. Unfortunately, yellow-bellied specimens are recorded also from Tobago, being said to match north-Venezuelan specimens. Most of the Tobago birds at hand have some yellowish tinge on the belly, but none of them matches the extreme of north-Venezuelan birds in this respect nor matches any north-Venezuelan specimen in regard to breadth or rufescence of wing-bars and outer margins of the secondaries.

I believe, therefore, that there is still something to be said for the separation of *vireoninus* from *cabanisi* although I should like to see more material before formally recognizing a Tobago form.

Upper Orinoco specimens are much like Tobago birds, though averaging even whiter on the belly and having the wing-bars narrower though equally dull in color. If "*vireoninus*" is recognized, it may be necessary to separate an Orinocan form also. It is even farther removed from typical *cabanisi* than is the Tobago series. Mt. Duida birds are quite distinct as described below.

A record from Iquitos undoubtedly belongs to *fuscatior*.

Cnemotriccus fuscatus duidae, new subspecies

TYPE from Playa del Río Base, Mt. Duida, Venezuela; altitude 550 feet. No. 274,504, American Museum of Natural History. Male, nearly adult, collected November 21, 1928, by the Olalla brothers.

DIAGNOSIS.—Most like *C. f. fuscatus* of southeastern Brazil but upper parts darker, less rufous brown, and under parts deeper yellow on the belly, warmer, less grayish, brown on the pectoral band, and yellow, rather than whitish, on the throat. General size smaller but bill averaging heavier. Differs from *C. fuscatus fumosus* of the Guianas by much browner back, usually deeper yellow under parts, broader and more rufescent margins of the tertials, broader and more deeply rufous wing-bars, and stronger bill with the mandible paler.

Compared with *C. f. cabanisi* of northern Venezuela, the upper parts are darker and browner, less grayish; the wing-bars are deeper rufous, the edges of the tertials more broadly marked with deeper rufous, more clearly defined; the superciliary stripe is less well marked; the under parts are much deeper yellow and the chest more brownish; the under wing-coverts are more deeply yellow; the bill is longer and has the mandible paler.

Compared with *C. fuscatus fuscatior* the upper parts are brighter brown, the under parts deeper yellow, the wing-markings more strongly rufous, and the mandible paler.

RANGE.—Southwestern Venezuela and northwestern Brazil; lower slopes of Mt. Duida, the Río Cassiquiare, and the upper Rio Negro.

DESCRIPTION OF TYPE.—Upper parts warm Buffy Brown × Olive-Brown, slightly brighter on the top of the head and approaching Prout's Brown on the rump and upper tail-coverts. Lores with upper part Pinkish Buff, continued rather indistinctly over the eye and auriculars to form a poorly defined superciliary stripe; auriculars brown at tips, paler and more buffy basally; malar region brown; throat Pale Olive-Buff × Marguerite Yellow; a broad pectoral band Light Brownish Olive, broadest and darkest on sides; belly Primrose Yellow; flanks narrowly olive brownish; thighs warm brown; under tail-coverts Marguerite Yellow. Wings sooty; primaries without pale edges [except toward base of outermost, a marking not shown by the type which is molting the outer primaries]; secondaries with conspicuous margins of Cinnamon-Buff except basally where their absence leaves a conspicuous, squarish, black patch; tips of secondaries included in the pale margins; tertials with outer edges broadly Avellaneous, the bright color occupying at least the outer half of the outer web of the innermost feather. Inner margins of remiges Pinkish-Buff; under wing-coverts Marguerite Yellow except toward bend of wing where there is a patch of light Saccardo's Umber. Tail Fuscous with brownish olive edges and indistinct pale tips. Maxilla black; mandible whitish, darker near tip. Feet dusky brown. Wing, 67 mm.; tail, 60; exposed culmen, 11.25; culmen from base, 15; tarsus, 16.5.

REMARKS.—Females similar to the males in general color but smaller; wing, 62 as against 67–69; tail, 56 as against 58.5–61.5.

Although I have seven specimens of this form, all of which show the characters of the subspecies, none of them is in full, fresh plumage. The specimens not in molt are worn and in poor condition. Hence I have chosen as type a skin which, although retaining a few feathers of immaturity, like the upper primary-coverts, is in the most nearly fresh adult plumage.

At first glance, *duidae* might be thought to represent a migrant population of typical *fuscatus* from southern Brazil, but the more intense yellow of the under parts is distinguishable even in worn specimens and I have both forms from their respective ranges at the same times of the year. Subspecific separation thus is indicated.

Four of the specimens have the mandible very pale; three, including the type, have it slightly darkened but distinctly paler than the blackish maxilla. Whether this difference is one of season or age I am unable to say. The same condition is observable in typical *fuscatus* although most specimens of the latter have the whole bill dark.

SPECIMENS EXAMINED

C. f. fuscatus.—BRAZIL: Bahia, 1 ♂, 3 ♀, 1 (?); São Paulo, São Sebastião, 1 ♂, 1 ♀; Rio Feio, 1 (?); Rio Grande do Sul, Lagôa de Forno, 1 ♂; Paraná, Guayra, 1 (?).

C. f. bimaculatus.—BRAZIL: Bahia, Giguy, 4 ♂; Jaguaquara, 1 (?); Santa Rita, 2 ♂; Sincorá, 2 ♂, 1 (?); Tambury, 2 ♂; São Paulo, Fazenda Cayoá, 2 ♂, 1 ♀; Piauhy, Parnaguá, 1 ♂; Patos, 1 ♀; Ceará, Viçosa, 1 ♀, 1 (?); Goyaz, Araguaya, 3 ♂, 1 ♀; "Goyaz," 1 ♀; Maranhão, Flores, 1 ♀; near Miritiba, 1 ♂, 1 ♀; Pernambuco, Garanhuns, 1 ♂, 1 ♀; Matto Grosso, Campanario, 1 ♂; Descalvados, 1 ♂; Urucum, 3 ♂, 1 ♀; Chapada, 5 ♂, 8 ♀, 3 (?); Agua Blanca de Corumbá, 1 ♂; São Lorenzo River between its mouth and the mouth of the Cuyabá, 1 ♀; Rio Madeira, Calamá, 1 ♀; Humaythá, 1 ♀; Igarapé Paituna, Fazenda Ponto, 1 ♂. Argentina: Ocampo, 1 ♂. Paraguay: Zanja Moroti, 2 ♂; Fort Wheeler, 1 ♂, Belon, 1 ♂; Colonia Independencia, 1 ♀.

C. f. fuscatior.—Ecuador: mouth of Río Curaray, 5 ♂ (incl. type), 2 ♀. Perú: Sarayacu, 4 ♂, 3 ♀; Lagarto, 2 ♂. Brazil: Rio Madeira, Rosarinho, 3 ♂, 1 ♀; Santo Antonio de Guajará, 4 ♂, 3 ♀; Rio Amazonas, Villa Bella Imperatríz, Santa Clará, 4 ♂, 1 ♀; Rio Tapajoz, Tauarý, 1 ♀; Rio Xingú, Villarinho, de Monte, 1 ♂, 2 ♀, 1 (?); Rio Tocantins, Baião, 1 ♂.

C. f. fumosus.—French Guiana: Approuague, 3 ♂ (incl. type), 3 ♀; Cayenne, 1 ♂, 1 ♀, 1 (?). Dutch Guiana: Ryweg, 1 ♂, 2 ♀; Paramaribo, 1 ♀. Brazil: Faro, 2 ♂; Mexiana, Nazareth, 1 ♂.

C. f. cabanisi.—Monos Island: 2 ♀. Tobago: Castare, 1 ♂, 4 ♀. Mondiland, 1 ♀; Waterloo, 1 ♀; Mariah, 1 ♀; Gecito, 1 ♀; Richmond, 1 ♀; "Tobago," 1 (?) (type of *canescens*). Venezuela: Cristóbal Colón, 1 ♀; Cuchivano, 1 ♂; La Florida, Cumanacoa, 1 ♀; Puerto La Cruz, 1 ♂; Tucacas, Falcón, 1 ♀; Las Trincheras, Carabobo, 1 ♀; "Venezuela," 1 (?); Río Apure, San Fernando, 1 (?); Río Orinoco, Altagracia, 4 ♂, 2 ♀; Caicara, 2 ♀; Las Barrancas, 1 ♀. Colombia: "Bogotá," 7 (?); Boca de Chimi, lower Río Magdalena, 1 ♂; Santa Marta, Concha, 1 (?); Bonda, 2 ♂, 2 (?); Valparaiso, 1 (?).

C. f. duidae.—Venezuela: Mt. Duida, Playa del Río Base, 2 ♂ (incl. type); Savana Grande, 2 ♂; Río Cassiquiare, Buena Vista, 1 ♀; Solano, 1 ♀. Brazil: Rio Negro, Yavanari, 1 ♀.

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A STUDY OF PROPORTIONAL CHANGES DURING THE POST-LARVAL GROWTH OF THE BLUE MARLIN (*MAKAIRA NIGRICANS AMPLA* POEY)[1]

By Sidney Shapiro[2]

ACKNOWLEDGMENT

The material which serves as the basis for this study was secured by the Michael Lerner Bimini Expedition of The American Museum of Natural History during July, 1937. This data consists of absolute measurements of numerous parts and organs of twenty-three specimens of the blue marlin, *Makaira nigricans ampla*, as given by Conrad and LaMonte (1937) in their paper on the description of the body form of this species. Many thanks are extended to Dr. William K. Gregory, under whose supervision this study was carried out, for his criticism and clarification of the problems raised in this paper, and to Dr. Edmund Sinnott for his useful suggestions concerning the methods and procedure. Acknowledgment is also made to Mr. G. Miles Conrad for his suggestions and criticisms and for his information concerning many details of the orginal material.

INTRODUCTION

The constant differential growth ratio of Huxley affords a means of studying the relation that various parts of an organsim have to each other or to the organism as a whole as that organism or its parts are increasing in size. The rates of growth of various parts are thus an indication of the proportional changes occurring during the period of growth of the individual. Proportions may change by the organ in question growing at a greater rate than another part of the body— positive heterogony (positive allometry, Huxley and Tessier, 1936) or at a slower rate— negative heterogony (negative allometry). In the former case the constant differential growth ratio would be greater than unity, and the growth rate of the dependent variable (the organ or part of the organism) is maintaining a greater growth per unit increase than is the independent variable (the organism as a whole; in this paper it is designated by the body length). In the case of negative heterogony the growth ratio of the dependent variable to the independent variable is less than unity, with the reverse relationship. Isogony (isometry, Huxley and Tessier, 1936) is a specific condition of heterogony; the unit increases in growth of the two variables being equal and the proportions thus remaining undisturbed.

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[1] Results of the Michael Lerner Ichthyological Expeditions. No. 13. Also the first in a series of papers to be titled, 'Studies on Heterogony (Allometry) in the Vertebrates.'

Previous publications in the Results of the Michael Lerner Ichthyological Expeditions series:

No. 1.—(Photographs). Natural History, January, 1937, pp. 58–59.
No. 2.—Conrad, G. M.: American Museum Novitates, 1937, No. 900.
No. 3.—Nichols, J. T., and LaMonte, F.: American Museum Novitates, 1937, No. 901.
No. 4.—Raven, H. C., and LaMonte, F.: American Museum Novitates, 1937, No. 902.
No. 5.—Weisman, A. I., Mishkind, D. I., Kleiner, I. S., and Coates, C. W.: Endocrinology, 1937, XXI, No. 3.
No. 6.—Nichols, J. T., and Raven, H. C.: Journal Mammalogy, 1937, XVIII, pp. 365–366.
No. 7.—Gregory, W. K., and Conrad, G. M.: American Museum Novitates, 1937, No. 952.
No. 8.—LaMonte, F.: Bulletin N. Y. Zoological Society, 1937, XL, pp. 190–196.
No. 9.—LaMonte, F.: Natural History, December, 1937, pp. 762–766.
No. 10.—Conrad, G. M.: American Museum Novitates, 1937, No. 968.
No. 11.—Conrad, G. M., and LaMonte, F.: Bulletin American Museum, 1937, LXXIV, Art. 4.
No. 12.—Nichols, J. T.: Copeia, 1937, No. 4, pp. 236–237.

[2] Columbia University.

The formula, $y = bx^k$, has been applied in its logarithmic form, $\log y = k \log x + \log b$ (Huxley, 1932), to numerous data and shown to yield a straight line for a considerable range of differential growth between whole organs and the remainder of the body; i.e., large chela of the male fiddler crab, *Uca pugnax* (Huxley, 1927), and of the prawn, *Palaemon malcomsoni* (Huxley, 1932); the jaws of certain fishes, *Lepidosteus osseus*, *Belone*, *Hemirhamphus far*, and *Polyodon spathula* (Needham, 1935), relative to the length of the remainder of the body.

This formula implies that for the range over which it holds the relative growth rate of one variable to the relative growth rate of the other variable remains constant, the ratio itself being denoted by the value k. This exponent, k, denotes a coefficient of ontogenetic relative growth, as each increase in size is partitioned to the various parts of the organism in accordance with the relative growth function. Growth, therefore, is used in the sense of change in size during ontogeny.

For the data dealt with in this paper the growth coefficient, k, has been determined by computing the slope for the line representing the relative changes in size, during post-larval development, of two growing organs or parts of the body of the particular organism here studied.

In order to facilitate the treatment of material which has not been classified as to sex and has been subject to unknown environmental conditions, a standard, body length (x in the equation), has been arbitrarily chosen, and in this study of changing proportions the values for other organs and parts (y in the equation) are treated as relative to this standard. Statistical methods, because the amount of data available did not warrant them, have not been applied to determine the reliability of the growth constants. Therefore, in the interpretation of the data, less significance has been placed upon the actual values of the constants than upon a comparison of the trends of growth exhibited by the various body measurements, all obtained in terms of increase in body length.

The coefficient *b*, which indicates what the value of *y* is when *x* is unity, can best be interpreted as providing the time element of any relationship. For example, at a *b* of zero the complex for the determination of both variables will begin to produce their characters, in conformity with the growth function, at the same moment. If the line of the curve crosses the abscissa or the ordinate it indicates that one of the characters has been produced in excess of the other for the time represented by the value of the intercept. In considering this statement it should be remembered that the percentage increase of the various organs may differ at various stages of development (Huxley, 1932; Needham, 1935), thereby resulting in altered intercept values. Therefore as no data on the larval growth of the material studied in this paper is available the significance of *b* cannot be interpreted in relation to the growth constant. The data available, however, show a considerable range in size, from 1950 mm. to 3040 mm. in length, and are sufficient for a study of proportional changes during the period of growth after all organs and parts of the body have fully differentiated.

The twenty-three specimens of the blue marlin can be considered as representing a post-larval ontogenetic series with a range in weight from 91 to 537 pounds. As growth progresses various readjustments and changes, dependent upon the respective growth rates, can be readily observed through the application of the logarithmic method. Genotypically the smaller marlin presumably does not differ from the giant sized specimen, but the size attained determines phenotypic differences which are self-evident only in the instances where body or organ changes are marked. At the same time a comparatively simple explanation—that growth is basically dependent upon the multiplication of living substance, each part of the organism having its own specific rate of development for a certain definite period of time determined by its genic complex—permits a ready explanation for changing proportions.

BODY WEIGHT

Keys (1928) finds that in the European herring (*Clupea harengus*, the California sardine, and the killifish (*Fundulus parvipinnis*) the body weight (*W*) increases more rapidly than the cube of the body length (*L*) multiplied by a constant (*a*) which is dependent upon the units in use and the general species form. When the logarithms of weight and length are plotted (Fig. 1) a straight line is obtained which conforms to the equation $W = a(L)^n$. The exponent n is indicative of the rate of change of weight with length and can be determined mathematically by solving,

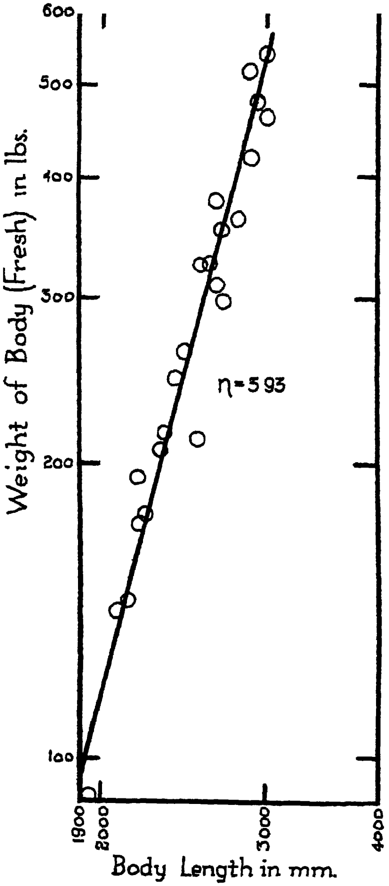

Fig. 1. Increase of body weight with increase of body length in the blue marlin, *Makaira nigricans ampla*. Logarithmic plotting both ways.

for any two points on the graph, the equation

$$n = \log W_2 - \log W_1/\log L_2 - \log L_1$$

or can be calculated directly by reading the slope of the graph. Marshall, Nicholls, and Orr (1937) obtained for the herring from the Clyde sea-area a similar result; the weight being proportional more nearly to the fourth power of the length than it is to the third. These results are in contradiction to the results obtained by earlier workers. Hecht (1916), on the basis of his study of eleven species of teleost fishes, concluded that weight is equal to a constant factor (dependent upon the "condition" of the fish at different seasons of the year) times the cube of the length. The rates of growth of various parts of the body (except depth) in terms of body length were identical, thus resulting in a body form that remains constant in each of the different species at various levels of post-embryonic development. The individual body form of a species Hecht attributed largely to variation in depth between species.

Because weight increases more rapidly than the cube of the length either the form of the fish or its specific gravity must change with adult growth. As specific gravity changes little in the balanced hydrostatic environment the conclusion is forced that the body form and therefore the proportions of the various dimensions are changing.

The present study of the blue marlin data confirms Keys' conclusion of the weight/length relation. The exponent n yields the value 3.93 (Fig. 1) and indicates that form change is occurring, even when the organs have been fully determined but are, as is characteristic of fishes, growing in the adult stages of their development. The blue marlin data adequately substantiates this hypothesis of form change by the fact that many of the organs and parts of the body are growing, during this period of indeterminate growth, that is being dealt with here, relatively faster or slower than the body length (Table 1).

FIGURES AND TABLES

The values of the growth constant, k, that have been determined for the part or organ relative to the body length are listed in Table 1. Graphic representations of differential growth ratios for various relationships are presented during the course of the text. Figure 2 has been drawn with the intention of illustrating the various proportional differences, which are to be described in detail, that are evident between a blue marlin which is 1950 mm. long and one that has attained a length of 3040 mm. These models have been reconstructed, not from the actual measurements of the parts and organs of specimens of these lengths, but from corrected readings taken from the logarithmic growth curves. Table 1. gives the actual measurements and the corrected readings for the organs and parts of the body that are listed.

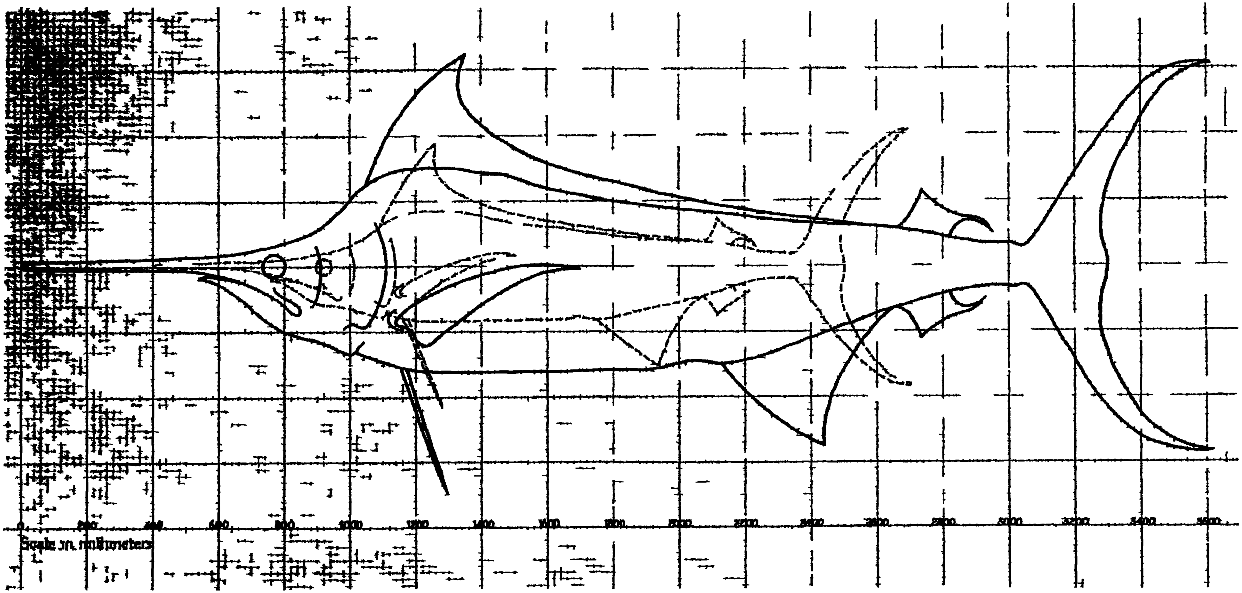

Fig 2 Reconstructions of blue marlins at levels of development corresponding to body lengths of 1950 mm (dash line) and 3040 mm (solid line)

TABLE I—Equilibrium constants for various body measurements (ordinates) plotted against the standard, body length (abscissa) of *Makaira nigricans ampla.* The measurements for the body length range from 1950 mm. to 3040 mm.

ORGAN OR PART OF BODY	Equilibrium constant *k*	Range of absolute measurements in mm.	Range of corrected measurements (taken from the graphs)
Snout tip to ant. bord. eye	0.88	490– 730	495– 730
Body depth (max.)	1.45	330– 670	330– 625
Snout tip to transv. plane of max. body area	0.90	840–1315	840–1240
Transverse plane of max. body area to tail base	1.10	1110–1725	1115–1800
Tip of snout to summit of back	1.10	840–1338	810–1300
Maximum spread of tail	1 00	712–1095	770–1180
A. P. length of tail, middle line from min. width of pedicle	1.24	107– 260	150– 260
Oblique length caudal fin, dorsal moiety	1.00	550– 840	545– 840
Oblique length caudal fin, ventral moiety	1.04	525– 775	505– 810
Minimum depth of pedicle	1 34	67– 120	66– 118
First dorsal fin, length of base	1.14	920–1531	920–1520
Depth of first dorsal fin, longest ray	1.15	290– 465	290– 485
Second dorsal fin, A. P. length	1 54	65– 158	77– 152
Second dorsal fin, depth longest ray	1.24	72– 125	73– 125
Anal fin, length at base	1.16	435– 760	435– 720
Anal fin, depth longest ray	1.24	245– 415	240– 410
Pectoral fin, width of base	1 44	60– 117	62– 117
Pectoral fin, longest ray	0 98	396– 598	390– 605
Greatest width of body	1.43	165– 320	165– 315
Width across caudal pedicle	1 54	55– 115	58– 112
Tip snout to post. bord. operculum	0.92	735–1122	740–1100
Ant. bord. eye to post. bord. operc.	1 00	240– 397	245– 380
Head depth supraoccipital to isthmus	1.30	180– 340	195– 345

Body Depth and Body Width

The value for the depth constant, in terms of body length, is 1.45 (Fig. 3), which indicates that for each unit increment of body length, the body depth increases progressively at the same unit rate although the increase in depth is 0.45 of a unit more than one. It can be assumed that a growth rate in which increase in body depth with respect to body length follows a trend in which the former variable shows greater growth per unit increase will necessarily provide for alterations in body form to occur concomitantly with increase in body weight. The added body weight is being distributed along the transverse diameter of the body to a more marked extent than it is being done lengthwise. Such changes are of importance to an organism that, in order to move about adequately in its liquid environment, must adhere to certain principles of streamlining.

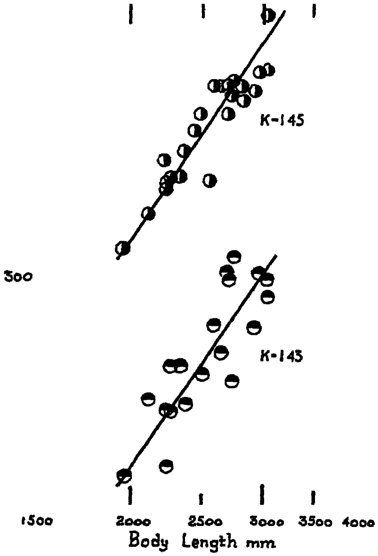

Fig. 3. Greatest width and greatest depth of body plotted against body length to show post-larval growth of these variables. Logarithmic spacing and measurements in millimeters both ways.

◑ greatest depth of body.

⊖ greatest width of body.

Conrad and LaMonte (1937), using the terminology developed by Gregory (1928*b*) to distinguish the highly variable body form of fishes, designate the body form, including the sword, of the blue marlin mesosomatic (length five times the depth) and in a few cases dolichosomatic (length more than five and a half times the depth). The logarithmic curve for the body depth/body length relationship (Fig. 3) indicates that the smaller blue marlins are slender and therefore dolichosomatic but because of greater unit increases in body depth the body form, with increase in size, changes and becomes mesosomatic. This change in proportion illustrates an interesting point in connection with streamlining; namely the change during post-larval development from a shallow entering angle to one that is relatively deeper.

Concurrent with the relatively greater increase in body depth there is a similar increase in the greatest width of the body, for which the rate of change in terms of body length yields a relative growth ratio of 1.43 (Fig. 3). Thus each unit increase in body length is accompanied by a greater and greater increase in body width, in conformity with the differential partition of growth in the two planes of length and maximum body width.

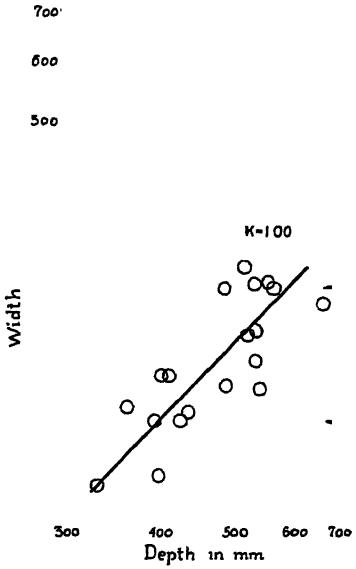

Fig. 4. Logarithmic graph showing increase of greatest width of body relative to increase of greatest depth of body.

It may be stated here that the two series of measurements of the depth and width of the pedicle taken at the minimum point of cross section also indicate that the transverse diameters of the body show a relatively greater partition of growth in this region; the constant differential partition of growth increments being 1.34 of a unit increase for the minimum depth of the pedicle as against each unit increase of body length and 1.54 for the increase of the width of the pedicle in terms of increase of the same standard. The probability is that if the added body weight is distributed to the transverse diameters of the greatest cross section and of the pedicle in a greater proportion than it is to the body length, other cross sectional areas of the body (of which no measurements are available) will show a similar partition of growth.

The greatest width of the body/body depth relationship (Fig. 4) with a value of unity serves as a check upon the validity of the measurements considered above and indicates that the aforementioned relative increase in body weight is not only partitioned to a more marked extent to the transverse planes of the body as growth progresses but equally so to the various points of the maximum body girth. Thus an oval cross section is maintained, the area of which increases isogonically in the vertical and horizontal directions.

The plotting of the data for greatest width of the body results in an unusual degree of variability which probably can be attributed to sexual activity or to unknown environmental conditions such as the amount of food in the digestive system.

The modal types, that is the specimens falling upon the line of best fit for the body width/body depth relation (Fig. 4), all conform to a mesothoracic condition (body width 50/100 of body depth). The stenothoracic (body width less than 45/100 of body depth) stragglers that Conrad and LaMonte (1937) mention are those specimens that fall on the limits of variability below the curve. The upper limits of variability include those stragglers in which the body width is about 60/100 of the body depth and therefore are included in the mesothoracic category, as Gregory (1928*b*) states the index for mesothoracic fishes to be one in which body width is 45/100 to 1/1 of body depth. It is interesting to note that because the width/depth relationship maintains an isogonic increase of growth increments, at all levels of development the limits of variability range from about 40/100 to 60/100 with a mode in which the width is 50/100 of the depth.

MOVEMENT OF TRANSVERSE PLANE OF MAXIMUM BODY AREA

The partition of growth increments to the component parts of the total body length is of use in determining whether or not the transverse plane of maximum body area maintains a position which remains relatively constant between the snout tip and the tail base as the body weight and size increases and the depth and width are growing proportionately greater. Evidence for a forward movement of this maximum transverse body area is obtained from a consideration of the measurements of the "snout tip to the transverse plane of maximum body area" and the "transverse plane of maximum body area to the tail base." Each, when plotted against the body length as the standard, exhibits a constant value for its relative growth rate, the former value being 0.90 and the latter 1.10 (Fig. 5). Thus in the course of post-larval development the streamline contours of the body are being altered in a manner to shorten the "entrance" of the fish through the water and increase the entering angle. The "run" is becoming relatively longer than the "entrance" and the angle formed by the postero-dorsal and the postero-ventral surfaces of the fish is smaller in specimens of greater size.

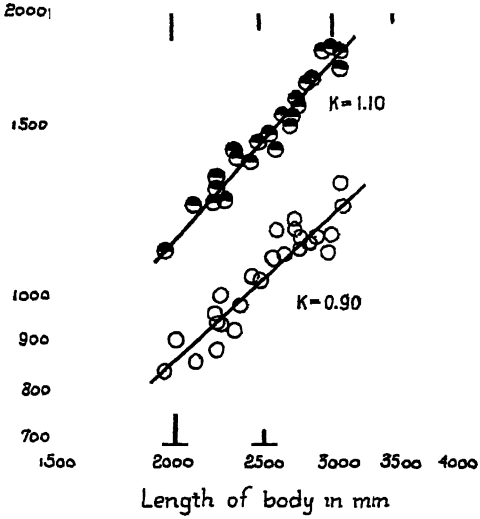

Fig. 5. Graph illustrating forward movement of greatest cross section of body. Abscissa represents length of body. Ordinates are: O–snout tip to transverse plane of maximum body area; ◒–transverse plane of maximum body area to tail base. Logarithmic plotting.

Caudal Fin

Dimensional growth of the component parts of the caudal fin, the determinations of which are remarkably constant and accurate, indicating that variation affects this organ but little, yield results which are of further interest in connection with the relation that further proportional changes may have to streamlining. Several of the dimensions of the caudal fin—the dorsal moiety, the ventral moiety, and the spread of the tail—show little or no change in proportions but there is a marked increase in the anterior posterior length of the tail measured from the

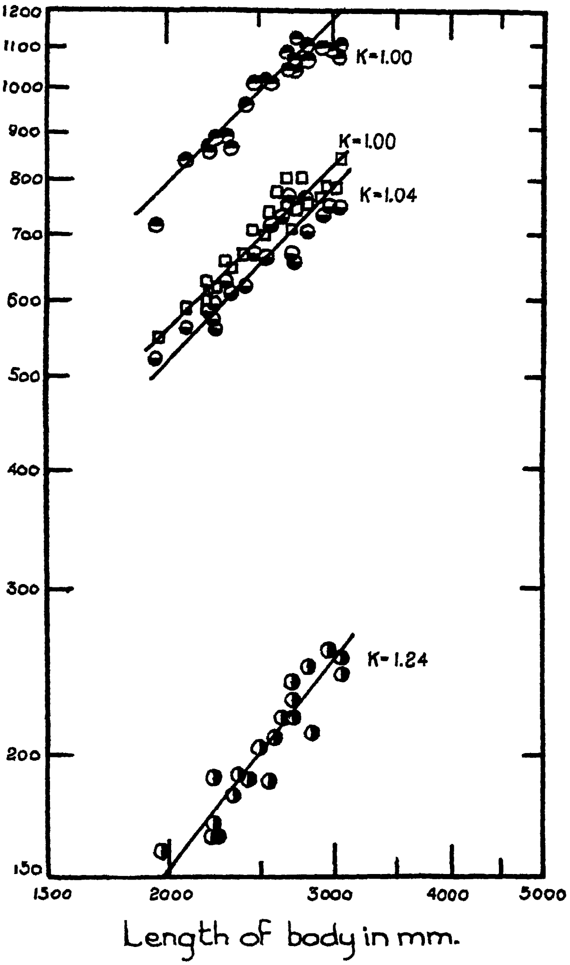

Fig. 6. Growth of dimensions of caudal fin (ordinates) relative to body length. Logarithmic plotting both ways.

⊖ maximum spread of tail.
□ oblique length caudal fin, dorsal moiety.
◓ oblique length caudal fin, ventral moiety.
◑ A. P. length of tail, middle line from min. width of pedicle.

minimum width of the pedicle. As the growth of this part of the fin is relatively greater than that of the body length ($k = 1.24$, Fig. 6), and as the remaining parts of the caudal fin maintain the same proportions to each other and to the body length in specimens of all sizes, the result is a change in the concavity of the tail in such a manner as to provide the larger fishes with less of a concavity.

This change in the concavity of the caudal fin brings out an interesting problem suggested by Breder (1926). Just how is the fork of the tail connected with the speed that the fish may attain? The realization that a change in the proportion of the concavity of the tail results with increased size emphasizes the necessity for understanding the importance of the fork of the tail as an aid or possibly a detriment to streamlining.

The explanation given by Nichols (1915 and 1920) for the fork in the tail of fish; namely the water displaced by the cephalic portion of the fish should meet immediately upon leaving the converging curves of the body, would seem to contradict the relatively greater extension of the anterior posterior length of the tail. The marked increases of the transverse diameters of the body, however, would necessitate a greater anterior posterior length of the tail in order to provide for a less abrupt "run" and thus permit the displaced water to merge back of the fin at the optimum angle. Vacuums or eddies presumably will not be created nor will on the other hand, as is the case with fish that possess a square tail, any parallel runs of water be present to impede forward motion.

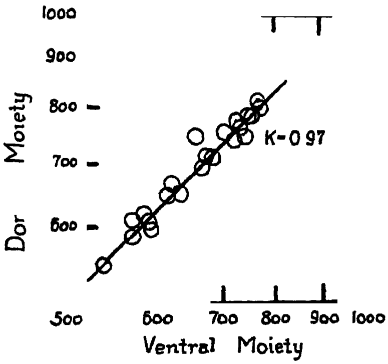

Fig. 7. Increase of dorsal moiety relative to increase of ventral moiety. Logarithmic plotting.

It is possible that the change in concavity may have less connection with streamlining than it does with the necessity for structural and mechanical modifications as the dorsal and the ventral moieties are becoming longer with increased size of the fish.

The tail, in the specimens of smaller size, is slightly although distinctly epibatic, but with greater size the tendency is for the attainment of a condition wherein the dorsal and ventral lobes will be symmetrical, although complete symmetry is not attained in any of the larger blue marlins. The growth gradient for the ventral moiety is slightly greater than that for the dorsal moiety (Fig. 6); the latter variable showing no proportional changes with body length ($k = 1.00$) whereas the ventral moiety shows a slight relative increase in terms of the standard ($k = 1.04$). This positive heterogony for the ventral moiety is extremely slight but is confirmed when its growth is plotted relative to the growth of the dorsal moiety, with a resultant greater partition of growth to the ventral lobe of the fin. The value of the constant is 0.97 (Fig. 7) and because of the almost perfect fit of the values on the growth curve it can be conceived as possessing some measure of reliability.

LONGITUDINAL APPENDAGES

The function of the longitudinal appendages—the first and second dorsals and the first and second anals—are primarily of advantage in steering the fish and acting as a brake in stopping side way thrusts of the sword (Gregory and Conrad, 1937). The rate of change of the length of the first dorsal fin with body length yields a proportional rate of increase of 1.14, indicating that as body length is increasing the relative increase of the length of the first dorsal is markedly greater by fourteen hundredths of one unit. The depth of the fin as measured by the length of the longest ray shows approximately the same relative increase with greater body size. Table 1 lists the growth constant values for the second dorsal and the anal (measurements of the anal are of the first and second anals combined) which are indicative of similar modifications; all showing positive heterogonic growth as compared with body length. Such results may be taken as an indication that with increased body size and the handicap of increased body weight the necessity is placed upon the fish of maintaining a greater efficiency in balancing and steering. Presumably this may account for the growth of fins conforming to a growth partition in which their area is increasing relatively greater than is the body length.

PECTORAL FINS

Breder (1926) in his discussion of the scombriform fishes states that "the pectorals are typically stiff and without much mobility and are used almost entirely for wheeling and turning." The results obtained for the proportional growth of the pectoral fins of the blue marlin indicate that with unit increase in body length the width of the base of the pectorals is increasing at a rate of nearly one and one half times greater ($k = 1.44$), whereas the length of the fin, taken by measuring the longest ray, is maintaining an isogonic increase in terms of body length. It would seem that there is a necessity for a more efficient means of turning the fish which could not be maintained with increased body size and weight unless the pectoral fin became proportionately larger. A stouter but not a longer one is the manifestation of such a mechanical requirement.

HEAD MEASUREMENTS

A detailed study of the head measurements, expressed as the rate of change of its component parts with body length, illustrates a number of details which are of importance in forward movement, as the head and the portion of the body anterior to the greatest cross section provides an entering wedge for forward motion of the fish. As stated previously the portion of the fish anterior to the greatest cross section is growing at a relatively slower rate than is the entire body length. When this anterior part of the fish is broken up into a number of its dimensions—the tip of the snout to the posterior border of the operculum, the tip of the snout to the anterior border of the eye, and the anterior border of the eye to the posterior border of the operculum—it becomes evident that each smaller part has its specific growth coefficient (Fig. 8). These coefficients are presumably in turn the sum of growth rates existing for still smaller component parts, just as the constant for the tip of the snout to the posterior border of the operculum yields a value which can be considered a component of the growth values for two of the dimensions composing this larger part. For example the length of the head as measured from the tip of the snout to the posterior border of the operculum is increasing at a smaller unit rate than the body length ($k = 0.92$). One of the components of this dimension, the snout, as measured from the tip of the snout to the anterior border of the eye, shows a somewhat smaller unit increase ($k = 0.88$). The relatively greater increase of the part extending from the anterior border of the eye to the posterior border of the operculum accounts for the difference in growth rates between the snout and the head including the snout. This variable, which is indicative of head length minus the snout, is having growth partitioned to it at the same rate as is the body length as a whole ($k = 1.00$).

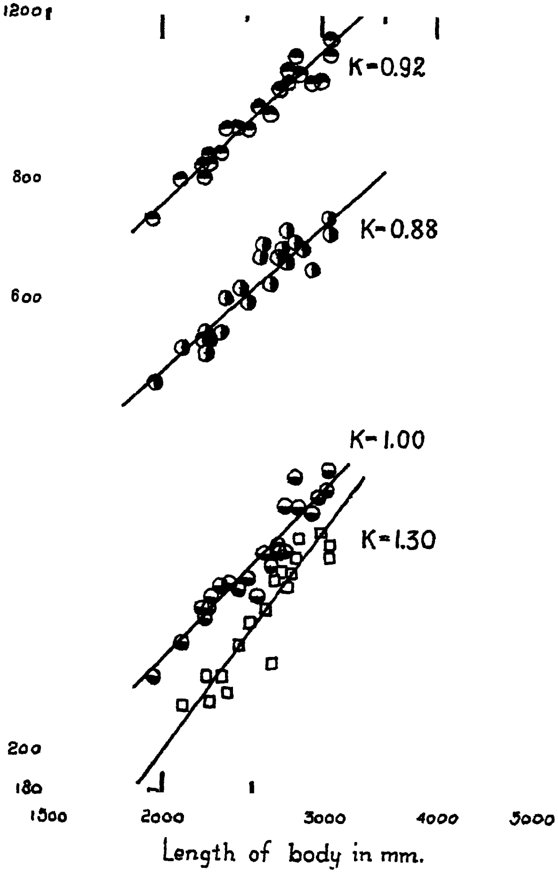

Fig. 8. Component parts of head (vertical values) plotted against length of body. Logarithmic plotting.

◓ tip of snout to post. bord. operculum.
◑ snout tip to ant. bord. eye.
◒ ant. bord. eye to post. bord. operculum.
□ head depth supraoccipital to isthmus.

It has been stated that the entering wedge of the blue marlin is becoming increasingly larger as the fish itself increases in size. Therefore it is to be expected that the head depth would show a corresponding relative increase. The value of the constant for change of head depth with body length is 1.30, but this falls short of the 1.45 value obtained for body depth, indicating that in the larger fishes the dorsal surface of the body from the snout to the summit of the back is becoming deeper and the concavity on the dorsal surface of the head is assuming a condition which indicates inferior streamlining of the body form in the larger specimens. Presumably a greater concavity would cause greater resistance to forward motion through the water as retarding eddies would be introduced. This is incompatible with Gregory's (1928*a*, p. 410) assumption that the size and proportions of the head to those of the body as a whole are regulated so that a streamlining which is presumably efficient results normally.

The prominence of the snout obscures the fact that relative to body length it is showing a decreasing amount of growth, the growth coefficient being 0.88. This negative heterogony is analagous to the result that Needham (1935) obtained for *Lepidosteus osseus,* where an early period of rapid growth is obtained in order to provide the young predacious fish with a jaw of adequate length for feeding purposes. As soon as the snout attains a required length, however, the growth rate becomes negative as it does in the blue marlin where lack of larval measurements make it only possible to suppose that the early growth of the snout was markedly heterogonic in a positive direction. Otherwise the snout could not have attained the prominence that it has.

DISCUSSION

The value of this study of growth is first that it tends to confirm the presence of a mechanism regulating the relative growth of the component parts of an organism as a simple function of the growth of the entire organism. Secondly it suggests that there is possibly a correlation between these seemingly precise growth rates and the necessity for such controlled changes. In the case of the blue marlin, increased size and weight places upon the organism the necessity of coping with the environment in a constantly differing way. The proportions of the various components are shown to change, but are these changes of mechanical and functional advantage in complying with streamline requirements? With the higher vertebrates growth proceeds to a definite stage of development and then ceases, except in a few isolated cases, i.e., in the voles (Hinton, 1926), in man (Hrdlicka, 1936). Fish go through a period of marked changes during the larval stage and then continue to grow and change less rapidly. This slow post-larval growth, with its relatively greater increase in body weight, is perhaps the main cause for various dimensions of the body growing disproportionately. Even if the medium does not affect the direction of growth of these dimensions by selection there may be a need for adjusting certain factors (size of the organs and parts) to maintain an efficient mechanism for the locomotion of the organsim as the body weight increases.

The positive or negative heterogony shown by the different parts of the blue marlin produce at each level of growth a body form proportionately different from an earlier stage. With the aid of such measurements and the means for reconstructing and testing representative models embodying such changes in proportions it should be possible to determine their value in relation to streamlining.

There are two alternatives possible in considering the time of development at which the factors for the production of the growth rates indicative of the post-larval stages have their initial effect. First, the heterogony exhibited by the various organs may have been determined during the early larval period of growth and the proportional changes in the adult phase of growth are not as marked as they are in the larval period where the actual rates of growth (the multiplication of living substance) are far more rapid than they are in the indeterminate period of growth studied. In such a case the relative rates of growth would remain the same or nearly the same for the entire life of the organism, the actual increments of organ increase per unit time being larger in the larval stage. This supposition would mean that determination of adult body form in the larval stage would reduce the emphasis that has been placed upon added body weight as being the contributing factor for proportional alterations in the relative sizes and shapes of the organs and parts of the body during post-larval development.

The alternative to relative growth rates being determined early in ontogeny is obviously a change at some period of development, probably at the time when differentiation of the organs have been fully completed, yet added growth and therefore added weight requires that there be some adjustment of proportions. Evidence for the latter belief is indicated by the results which Needham (1935) obtained. Growth of the jaws of *Lepidosteus osseus*, *Belone*, and *Hemirhamphus* relative to the rest of the body show two distinct periods of growth, the growth coefficient being much greater in the first than in the second period. This difference in growth rates is correlated with differences in the histology of the growing jaws and with larval adaptation by the young fish of the predacious elongated jaws of the adult.

SUMMARY

Huxley's relative growth method is used to measure the relative amounts of growth exhibited by various organs and parts of the blue marlin (*Makaira nigricans ampla*). The exponent k in the equation $y = bx^k$ denotes a coefficient of partition of growth increments and is thus an indication of the proportional changes occurring during the post-larval development of the fish.

Body weight increases more rapidly than the cube of the body length. This indicates that form change is occurring during the indeterminate period of growth of the blue marlin.

The added body weight is being distributed along the transverse diamaters of the body to a more marked extent than it is being done lengthwise. Because of these proportional changes the dolichosomatic body form of the early post-larval fish assumes a mesosomatic condition.

The transverse plane of the maximum body area shows a constant relative forward movement as the fish attains greater size. This alters the streamline contours of the body so as to shorten the "entrance" of the fish through the water and lengthen the "run."

The concavity of the caudal fin becomes increasingly shallower as the fish becomes larger. This is brought about by a relatively greater extension of the anterior posterior length of the fin while the other components show almost no proportional changes.

The longitudinal appendages all show positive heterogonic growth in terms of increase in body length.

Proportional changes of the pectoral fin are evidenced by a relative increase in the stoutness of the fin. The length increases isogonically in terms of increase in body length.

The component parts of the head all show different rates of growth. Relative to the body length the snout shows a decreasing amount of growth.

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PARASITES OF THE SWORDFISH, *XIPHIAS GLADIUS* LINNAEUS[1]

BY ROSS F. NIGRELLI[2]

The parasites were collected from the broadbill swordfish taken by the Lerner-Cape Breton Expedition of The American Museum of Natural History at Louisburg, Nova Scotia, during the summer of 1936.

Four species of cestodes, one species of nematode, and one species of copepod were present in the collection. Of the cestodes, one new species is here reported; all the other parasites have been previously described. The present paper also reviews other parasites of the swordfish reported in the literature.

TREMATODES

Although no trematodes were present in the collection, several species are known to occur in the swordfish. Two of these are monogenetic and found on the gills. Goode (1880), in his paper on 'Materials for a History of the Swordfish,' reported *Tristomum coccineum* Cuvier, 1817, and *T. papillosum* Diesing, 1836. Goto (1894) reported a third species as *T. rotundum*, but this is definitely a synonym of *T. coccineum*. Of the two species, *T. coccineum* is the better known. Linton (1898) reported the presence of the parasite on the gills of swordfish taken at Woods Hole, Mass.

These trematodes are broad, flat, and oval in shape. There is a pair of anterior suckers, one on each side of the mouth. At the posterior end there is a large ventral sucking disc. The intestine has numerous lateral branches; testes are numerous, intracecal, and located posterior to a single ovary. Male and female openings are separate, anterior, ventral, and near the lateral margin of the body.

Tristomum papillosum differs from *T. coccineum* in that the hind sucker is situated closer to the posterior margin and the dorsal surface is covered with many papillary appendages. This species is yellowish white in appearance while *T. coccineum* is vermilion red.

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[1] Results of the Michael Lerner Ichthyological Expeditions, No. 14.

[2] New York Aquarium.

One species of digenetic trematode often found in the stomach of the swordfish belongs to an interesting group of large forms referred to the genus *Hirudinella* Garsin, 1730. The history and synonymy of the group is rather complicated. Manter (1926) redescribed this parasite of the swordfish from the collection of Dr. H. B. Ward and named it *Hirudinella fusca* (Poirier, 1885) (= *Distomum fuscum* Poirier) (= *D. verrucosum* Poirier) (= *D. clavata* of Linton, 1898). However, according to Stiles and Hassall (1908), the name *Distomum fuscum* Poirier should read *D. fuscum* (Bosc, 1802) Poirier, 1885. Bosc originally described the parasite as *Fasciola fusca* from the stomach of the "dorade" (Coryphaenae?). Therefore, Manter's name for this parasite should have been *Hirudinella fusca* (Bosc, 1802). But according to Baird, 1853, *Hirudinella fusca* (Bosc, 1802) is a synonym of *Hirudinella ventricosa* (Pallas, 1774) (= *D. ventricosum*) (= *Fasciola ventricosa*). For this reason, if Baird's opinion is correct, the name of the swordfish parasite described by Manter (1926) becomes *Hirudinella ventricosa* (Pallas, 1774). *Distomum coryphaenae hippuridis* Tilesius, *D. coryphaenae* of Rudolphi, and *D. clavatum* of Owen are also considered synonyms of *Hirudinella ventricosa* (see Stiles and Hassall).

Manter's (1926) description of *H. ventricosa* is based on 60 specimens varying from 7 to 23 mm. in length and from 2.5 to 5 mm. in width. The body is strongly marked with transverse folds and the region anterior to the ventral sucker (acetabulum) is narrower than the region posterior to this sucker. The mouth and oral sucker are sub-terminal, the acetabulum is large; and the body wall is thick. The oral sucker opens directly into the pharynx; the esophagus has two lateral "crops" which are directed dorsally and anteriorly. From the esophagus, two intestinal rami pass posteriorly filling the entire hind end of the body. The excretory pore is at the posterior tip of the worm; the genital pore is median, ventral, and near the oral sucker. The testes lie obliquely behind the acetabulum. The seminal vesicle is anterior to the sucker, and leads into the cirrus sac; the latter contains the pars prostatica, the terminal portion of the uterus and the ejaculatory duct. The ovary lies just posterior to the testes and the oötype (Mehlis' gland) posterior to the ovary. The uterus coils posteriorly between the two intestinal branches up to the anterior border of the hind third of the worm.

According to Stiles and Hassall (1908), Blainville, 1824, was the first to place a member of this group in the genus *Hirudinella* and in 1828 designated *Hirudinella clavata* (Menzies, 1791) (= *Distomum clavatum*) (= *Fasciola clavata*) as the type. This parasite is found in the stomach of *Scomber pelamys.* Such forms as *Hirudinella marina, Distomum scombri pelamidis* Tilesius, and *D. coryphaenae* (Bosc) (= *Fasciola coryphaenae*) are considered synonyms.

Hirudinella clavata has also been described from the stomach of the swordfish. Although it has been shown that trematodes described as *Distomum clavatum* by Owen and Linton are now regarded as *Hirudinella ventricosa,* it cannot be stated with certainty that *Hirudinella* (*Distomum*) *clavata* described from the swordfish by other investigators (see Stiles and Hassall) are likewise referable to this species. The fact that a single species of worm parasite may be described from a great variety of hosts is well known. Until further studies have been made, those forms described from the stomach of the swordfish as *Distomum clavatum* must remain as *species inquirenda.*

Besides *Distoma ventricosa* = *Hirudinella ventricosa,* Goode (1880) mentions a second species of digenetic trematode from the intestine of the swordfish described by Rudolphi, 1819, as *Distoma dendriticum.* Looss (1899) pointed out that the name *Distoma* is not a generic but a group name, and therefore referred this species to the genus *Dicrocoelium.* However, this genus, like *Fasciola,* included a great variety of forms and since then has been reserved for trematodes infecting warm-blooded animals. Since its exact taxonomic position is not known, *Distoma dendriticum* Rudolphi also remains as *species inquirenda.*

MacCallum and MacCallum (1916) described an interesting monostome from the gill cavity and muscle of swordfish taken at Woods Hole, Mass. They named this parasite *Koellikeria xiphiados.* Recently, Ishii (1935) in a revision of the family Didymozoonidae referred this swordfish monostome to the genus *Didymocystis* Ariola, naming it *D. xiphiados* (MacCallum and MacCallum, 1916) (= *Koellikeria xiphiados*). The members of this genus have the following characters: didymozooninae encysted in pairs. Forebody slender, elongated. Hindbody swollen, reniform, comma-shaped or semiglobular. Oral sucker present or absent. Pharynx present. Ventral sucker absent. Intestine present. Genital pore near oral sucker. Testes tubular, more or less elongated in hindbody, and begin near base of forebody. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Uterus long, with exceptionally large numbers of eggs.

CESTODES

I.—**Dibothrium plicatum** Rudolphi, 1819

Figure 1[1]

Echinorhynchus xiphiae Gmelin, 1790
Bothriocephalus truncatus Leuckart, 1819

GENERIC CHARACTERS.—Head short, oblong, orbicular, unarmed; bothria two, lateral, each with a shallow concavity and thickened edges. Neck long, ripe proglottids short, sharply emarginated at the posterior end.

Two complete specimens were present in the collection. One measured 75 mm. in length and 10 mm. in width. The neck region was only 4 mm. in length. The other complete worm measured 100 mm. in length and 7 mm. in width, while the neck region was extended to 15 mm. The bothria are slightly concave with thick edges, the posterior borders projecting slightly. The entire neck is usually found enclosed in a cyst-like structure buried in the lining of the digestive tract. In one case, the necks of two worms were found in the same cyst, which superficially gave it an appearance of a double-bodied monster. These are sexually matured cestodes and the strobilia at the anterior end are narrower and less emarginated than those of the posterior segments.

This species was first described from swordfish of American waters by Linton in 1891.

With the exception of the above species, all the cestodes to be described belong to the large group of fish tape-worms known as the Tetrarhynchidea. Since the complete life-history is not known for any of the marine species, Dollfus (1929, 1930) divided the order into two groups: Acystidea in which the larva is a plerocercoid; and Cystidea, in which the larva is a tailed or tailless cysticercoid (plerocerous). In 1935, however, he states that this division is "tout à fait inexact," for the larval stages of *Nybelinia* and *Tentacularia* which were considered plerocercoid were actually plerocerous forms without their blastocysts, i.e., reduced to a scolex with an appendix. Furthermore, it has been shown that any of the larval tetrarhynchids can re-encyst in other fish, which accounts for the presence of a single species in a great variety of hosts.

The classification used here for the tetrarhynchids of the swordfish is based on Dollfus' (1929) interpretations of the various genera. He reduced the number of the already described genera from 36 to the following 14: *Tentacularia* Bosc, *Floriceps* Cuvier, *Gymnorhynchus* Rudolphi, *Dibothriorhynchus* Blainville, *Pterobothrium* Diesing, *Tetra-*

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[1] Photographs by S. C. Dunton, N. Y. Aquarium.

rhynchobothrium Diesing, *Otobothrium* Linton, *Eutetrarhynchus* Pintner, *Lacistorhynchus* Pintner, *Sphyriocephalus* Pintner, *Nybelinia* Poche, *Grillotia* Guiart, *Armandia* Guiart, *Gilquinia* Guiart. To this list he added four new genera: *Sbesterium, Oncomegas, Poecilancistrium* and *Trigonolobium,* which brings the total to 18.

With the exception of *Hepatoxylon* Bosc, which was placed among *genera inquirenda,* the following were either discarded or reduced to synonomy: *Anthocephalus, Balanforus, Bothriorhynchus, Acanthorhynchus,* *Tetrarbothriorhynchus, Stenobothrium, Synbothrium, Syndesmobothrium, Aspidorhynchus, Abothros, Coenomorphus, Wageneria, Halysiorhynchus, Acoleorhynchus, Bouchardia, Rufferia, Pierretia, Vaullegeardia,* and *Dibothriorhynchus* of Diesing.

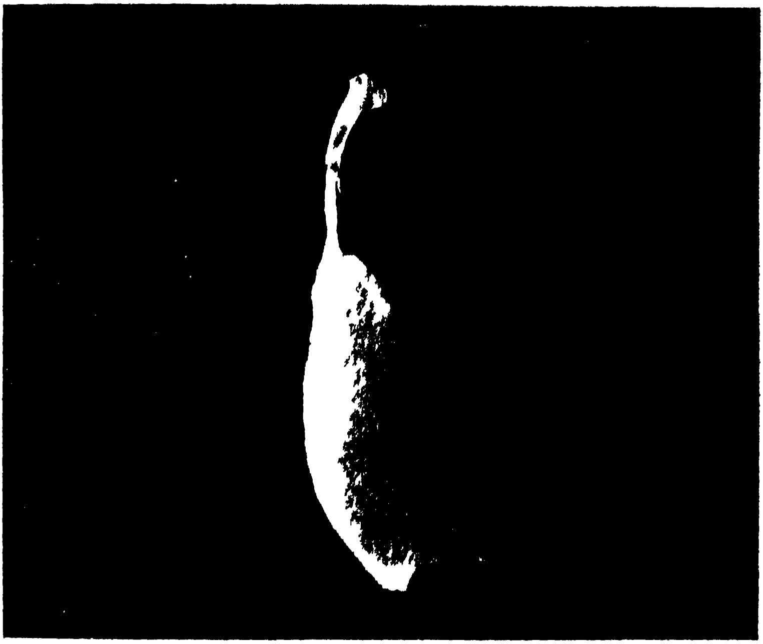

FIG. 1. *Dibothrium plicatum* Rudolphi. About × 2 (incomplete worm).

Both *Tetrarhynchus* and *Rhynchobothrium,* like *Distomum* of the trematodes, are group names. The large number of cestodes described under these two genera have since been reclassified and distributed among the recognized genera mentioned above. Thus the tetrarhynchid parasites of the swordfish, formerly described under these two genera, have now been placed in one of the following genera: *Tentacularia*, *Nybelinia*, or *Dibothriorhynchus*.

II.—**Dibothriorhynchus attenuatus** (Rudolphi, 1819)

Figure 2

Tetrarhynchus attenuatus Rudolphi, 1819
Tetrarhynchus attenuatus of Olsson, 1868
Bothriocephalus claviger (Leuckart, 1820)
Coenomorphus linguatula of Lönnenberg, 1891
Rhynchobothrium attenuatum (Rudolphi) of Linton, 1896, etc.
Dibothriorhynchus xiphiae MacCallum, 1921

The genus is characterized as follows: larval plerocercoid; body more or less flattened, linguiform in short individuals, ribbon-like in long forms, smooth in expanded individuals and wrinkled in contracted worms. Posterior end of the body terminates in a small retractile protuberance, tip of which contains the excretory pore. The thickened anterior region containing the bothria is sharply demarcated from the rest of the body. Bothria two, deep, strong, varying in shape with the state of contraction. Bothroidal cavity separated into two by a longitudinal fold, more or less pronounced posteriorly, but not a true septum. Bothria deeply encased in the body of the scolex. Posterior borders of the bothria thickened. Proboscides short, thick, club-shaped, or globulose; rigid and straight. The hooks are hollow, similar in size except at the base where they are slightly smaller; all uniformly arranged. Pars vaginalis relatively short; retractile bulbs slightly elongated, oriented obliquely or transversely.

Dibothriorhynchus attenuatus is a larval cestode that is usually found in large numbers in the body cavity of the swordfish. Linton (1896) recovered over 50 specimens from four fish. These were found attached to the peritoneal lining of the stomach and intestine. The present collection contains 23 worms, ranging in size from 27 × 4 mm. to 70 × 5 mm. In strongly contracted worms, the body is wrinkled, while in the expanded state the body is more or less smooth. Four hooked proboscides are present, two on each bothrium. They are club-shaped, measuring a little more than one millimeter in length, and controlled by powerful muscles which are inserted in each of four retractile bulbs. The name "retractile bulbs" is not suitable for these peculiar organs, however, for not only do they serve to contract the proboscides but also to force them out through the sheaths.

MacCallum (1921) reported a species which he called *D. xiphiae*.

These were about the same size as the smaller of *D. attenuatus* but without any specific differences. Therefore *D. xiphiae* is considered synonymous with *D. attenuatus.*

According to Linton (1925) the sexually matured stages of related species of *Rhynchobothrium* = *Dibothriorhynchus* are usually found in the spiral valves of sharks and rays. It is assumed, therefore, that the adult of *D. attenuatum* may eventually be found in similar hosts.

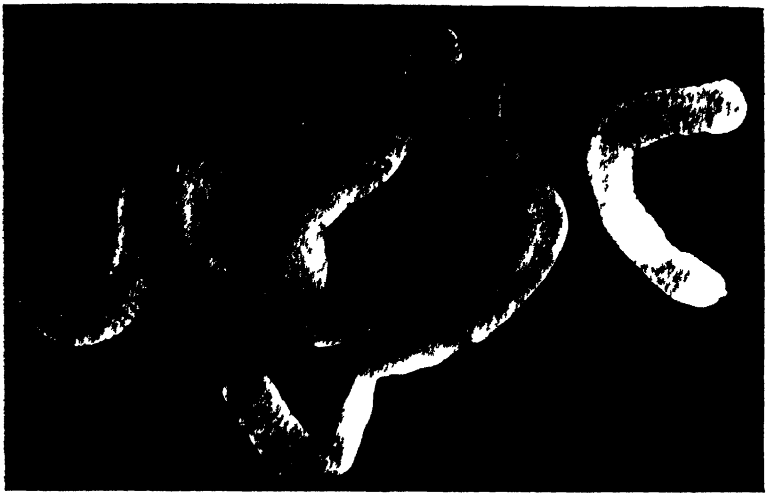

Fig. 2. *Dibothriorhynchus attenuatus* (Rudolphi). About × 2

Two other species of larval *Dibothriorhynchus* have been reported from the swordfish by Linton. In his 1925 paper, he stated that in 1904 he found a few cysts of *Rhynchobothrium imparispine* = *Dibothriorhynchus imparispine* (Linton, 1891) from four swordfish. The adult stage of this species is a common parasite of skates belonging to the genus *Raja.* Again in 1925, he described a new species as *R. uncinatum* = *D. uncinatum* (Linton, 1925). The larval stage of this species was found by V. N. Edwards in the flesh of the swordfish attached to the backbone. The adult and matured stages were found in the thrasher shark, *Vulpecula marina.*

III.—**Tentacularia coryophaena** Bosc, 1802

Bothriocephalus bicolor Bartels, 1832
Tetrarhynchus bicolor (Bartels) Linton, 1896, and others
Tetrarhynchobothrium bicolor of Diesing, 1854

The genus is characterized as follows: larva plerocercoid; body elongated, somewhat cylindrical, composed of a head region and an appendix. Retractile papilla present at the posterior end and contains the excretory pore. Bothria four, extending from the anterior extremity of the body to the base of the appendix; their lateral borders forming eight parallel lines, scarcely raised from the surface of the body, sometimes indiscernible. Each bothrium possesses five grooves: a median one (sulcus intrabothridialis), a right and left one (sulcus bothridialis), and one on the outside of each of these (sulcus circumbothridialis). In the region between the two bothria there is a deep groove called the sulcus medianus. In the area in front of the sulcus circumbothridialis, four small circular orifices are present. These are the cylindrical tubes (rhynchodaeum) through which the proboscides project. The proboscides are short, slender, and slightly curved at the base, gradually widening toward the tip. The hooks are solid, small and slender, regular in arrangement and uniform in distance apart. The basal hooks are small, short, and thick. Retractile bulbs are relatively small, elongate, and banana-shaped.

Linton (1896) first reported the parasite in North American Swordfish. His description for this species is rather incomplete, but the one specimen from the present collection, besides showing the above generic characters, compares favorably with those given by Linton. The dimensions of the specimen (stained and mounted) on hand are as follows: total length 4 mm., width 2.5 mm; length of proboscides 1 mm., width 0.1 mm.; length of contractile bulbs 0.9 mm.; average length of the largest hooks 0.03 mm.

IV.—**Nybelinia lamonteae**, new species

Figures 3 and 4

Generic Characters.—Larva plerocercoid; body composed of so-called head and appendix, shape varying with the state of contraction of the individual. Scolex ordinarily cylindrical, short, and contains bothria which are rounded at the apex and projecting at the lower borders. Retractile papillae is at the extreme end of the appendix and contains the excretory pore. Bothria four, variable in shape, marginal thickenings large; area between adjacent bothria narrow, sometimes lacking, which makes it superficially appear as if only two bothria were present. Ventral and dorsal surfaces of bothria well separated anteriorly, but in contact with each other by their posterior borders. On the right and left sides, the bothria are in contact with each other anteriorly but separated posteriorly. Apex of scolex more or less rounded. The orifices through which the proboscides project are definitely arranged in pairs (2 dorsal and 2 ventral). Hooks variable in number and size. Proboscis sheaths slightly longer than proboscides. Retractile bulbs relatively short, elongate, banana-shaped in certain forms and ellipsoidal in others.

Description of Type.—Number 13769, American Museum of Natural History.

The present species is distinguished from those previously described from the swordfish by the shape of the proboscides, the arrangement of the hooks on each proboscis, and the presence of closely set spines or spicules around the periphery of each bothrium. The proboscides (Fig. 4) average 0.5 mm. in length. The anterior end of each is spear-head-shaped. This part measures 0.15 mm. in length and 0.12 mm. in width at its base. Large curved hooks are present in approximately the anterior half of the "spear-head" and average about 0.045 mm. in length. The hooks of the posterior half are arranged in rows in an

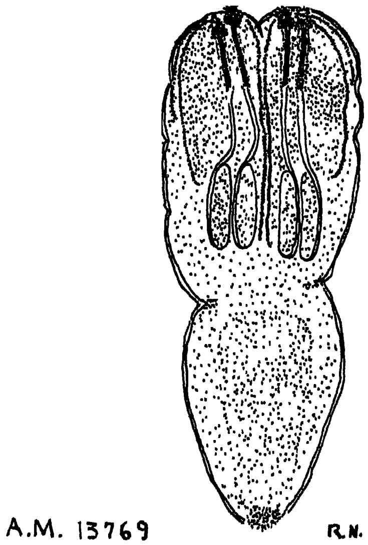

Fig. 3. *Nybelinia lamonteae,* type. × 20

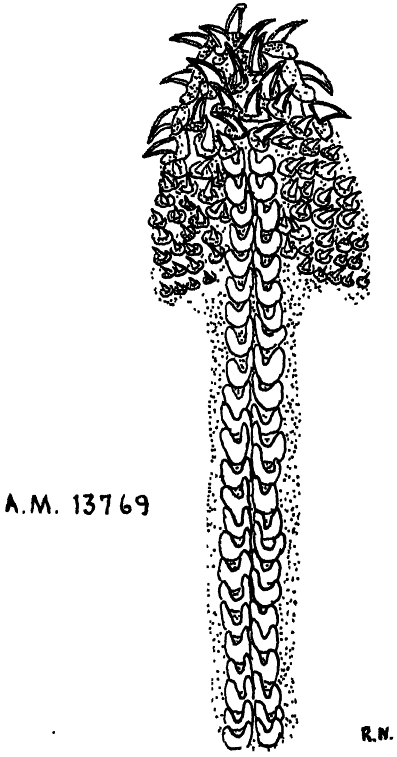

Fig. 4. Proboscis of *Nybelinia lamonteae.* × 210

orderly manner and are from one-third to one-half the size of the larger ones. There are about 20 pairs of hooks that pass posteriorly along the proboscis sheath. These are about as large as the hooks at the anterior end.

The worm was found encysted in the mesentery of the swordfish and measures about 7 mm. in length and 2.5 mm. in width. Figure 3 shows this cestode. This specimen was slightly flattened and stained with paracarmine. The head is composed of four bothria and the margin of each is armed with closely set spines or spicules. The proboscides are retracted within the sheaths and each proboscis is connected to a muscular retractile bulb. These bulbs, which control the extension and contraction of the proboscides, average about 0.8 mm. in length. The central part of the appendix is densely granular and stains a deep red with the paracarmine, as does the retractile papilla.

In all probability the mature stages of this species will be found in the spiral valves of some species of elasmobranch. Except for the shape of the proboscides and arrangement of the hooks, *Nybelinia lamonteae* closely resembles *Tetrarhynchus narinari* MacCallum, 1917, an adult form found in the spiral valves of the ray, *Aetobatis narinari.* According to Dollfus (1930) *T. narinari* is synonymous with *Nybelinia robusta* (Linton) (= *T. robustum* Linton, 1891).

One other species of *Nybelinia* has been found in the swordfish. In 1925, Linton reported the finding of several cysts of *T. bisulcatum* (Linton, 1891) (= *Rhynchobothrium bisulcatum,* 1889) on the viscera, and a few scoleces in the digestive tract probably introduced with food. Again, according to Dollfus (1930), *T. bisulcatus* is a synonym of *Nybelinia bisulcata* (Linton). The adults of this species have been found in the stomach of *Carcharhinus milberti, C. obscurus, Galeocerdo articus* and *Squalus acanthia.* MacCallum (1921) also found the mature stage in the stomach of *Cestracion zygaena.*

Several other species of cestodes have been recorded for the swordfish. Linton (1925) found a few larval cysts of *Otobothrium crenacolle* Linton, 1891 and *O. dipsacum* Linton, 1896 in the peritoneal coating of the pyloric caeca and viscera. The adult of *O. crenacolle* has been reported from the spiral valves of sharks, while that of *O. dipsacum* is not as yet known. The members of the genus *Otobothrium* are characterized by the presence of two ciliated pits at the posterior border of each of the two bothria. The proboscides are four, terminal, filiform, armed, and retractile into a neck.

A great variety of larval forms, the exact taxonomic positions of which are not known, have been described from the swordfish. They have been placed under a group name designated by Rudolphi as *Scolex polymorphus*. These are usually found in the intestine of the host, and are in all probability that stage in the life-history intermediate between the one found in the Arthropod or Molluscan hosts (procercoid) and the final larval stage in the swordfish (plerocercoid). These may develop into any of the above mentioned larval cestodes and the final, or adult stage may be found in some species of elasmobranch.

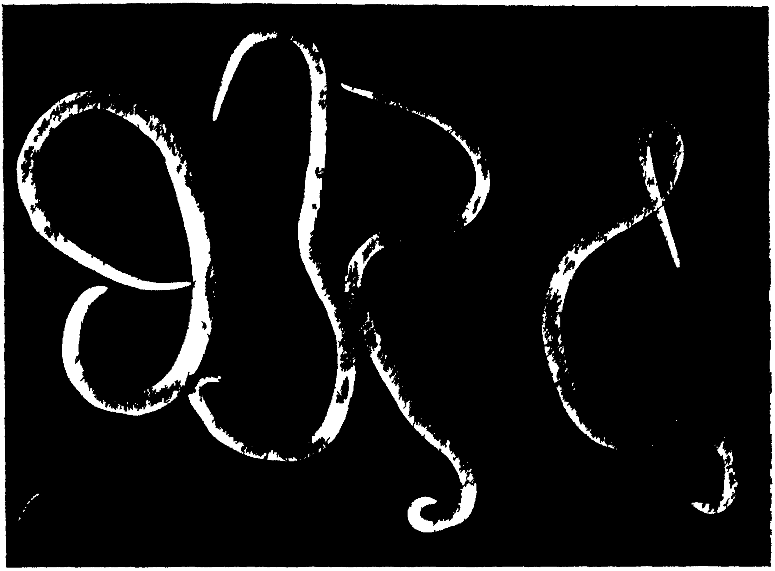

Fig. 5. *Contracaecum incurvum* (Rudolphi). About × 2

NEMATODES

V. -**Contracaecum incurvum** (Rudolphi, 1819)

Figure 5

Ascaris incurva Rudolphi, 1819

The members of this genus have the following characters: interlabia present, usually well developed; dentigerous ridges absent; esophagus with reduced posterior ventriculus, giving off a solid posterior appendix; intestinal caeca present; male without definite caudal alae; three to four pairs of postanal papillae (may be doubled), and numerous preanal papillae; spicules equal; gubernaculum usually absent. In the female the ulva is present in the anterior part of the body; oviparous.

The parasite has long been known from the swordfish. It was present in both Cobbold's (1867) and Linton's (1899) collection of worms taken from this host. Walton (1927) found the parasite in the Leidy collection, which he revised. It was Baylis and Daubney (1922) who definitely allocated this species and placed it in the genus *Contracaecum.* Yorke and Maplestone (1926) and Walton (1927), also refer to it as *C. incurvum.*

The present collection contained 16 specimens, varying in size from 15 mm. to 110 mm. in length; from 0.45 mm. to 0.76 mm. in width. The body is finely striated and serrated at the margins. Head truncate 0.3 mm. in length and width. Esophagus 0.15 mm. in diameter; ventriculus 0.16 mm. in diameter; esophageal appendix 3.5 mm. in length. Distance from the cloacal opening to the tip of the tail 1 mm.; tail tapering sharply, measuring about 0.4 mm. in length. Ventral surface of the caudal region, forward from the cloaca, cuticle raised into ridges. 15 to 16 pairs of preanal papillae; one pair of adanal papillae; 2 ventral and 2 lateral postanal papillae.

COPEPODS

Several species of copepods have been described from the swordfish, but only one species was present in this collection.

VI.—**Pennella filosa** (Linnaeus)

Pennatula filosa **Linnaeus, 1758**
Penella plumosa **of Linton, 1925**

Wilson (1917) redescribed the parasite and referred to it as *Pennella filosa.* According to this investigator, *Pennella plumosa* (De Kay) is synonymous with *P. sagitta* (Linnaeus), both reported from *Diodon.* The form referred to by Linton (1925) as *P.* (*Penella*) *plumosa,* in the writer's opinion, is *P.* (*Pennella*) *filosa* since this form is consistently found on the flesh of the swordfish.

The members of this genus have the following characters for the female, according to Wilson (1932): trunk straight; legs close together near the head; ovisac filiform, eggs uniseriate; abdomen with feather-like processes.

One specimen in the collection. The head is wider than long, truncated at the anterior end, and possessing papillae of uniform size and distribution. Total length 180 mm.; neck 85 mm. in length and 3 mm. in diameter; trunk 65 mm. in length and 6 mm. in width; abdomen 30 mm. in length. Plumules profusely branched. Egg strings 200 mm. in length (broken), usually twice the body length.

Wilson (1917) described another species of *Pennella* from the swordfish which he called *P. instructa.* This form differs from the one above in that the head possesses concave lateral margins and the papillae are in definite area only; plumules 24 on each side of the abdomen and dichotomously branched.

Several other species of copepods have been described from *Xiphias gladius,* and like the majority of forms are not host specific. Both *Caligus rapax* Milne-Edwards 1840 and *C. chelifer* Wilson (1905 *b*) were found to occur on the body surface of the host. The members of this genus have the following characters: head fused with the first three segments, fourth segment free with the dorsal plates lacking; genital segment also without dorsal plates; abdomen 1- to 4-segmented. Frontal plates with lumules; first and second antennae 2-segmented; maxillae simple spines; first and fourth legs uniramose; second and third legs biramose. Rudiments of a fifth and sometimes sixth pair of legs on the lateral margins. Egg string often longer than the entire body.

In *C. rapax* the genital segment is wider than long; abdomen 1-segmented; dorsal surface with irregular pigment spots, while in *C. chelifer* the genital segment is as long as wide or longer; no pigment spots on the dorsal surface; abdomen 2-segmented, three times as long as wide.

Gloiopotes ornatus is another copepod parasite described from the swordfish by Wilson (1905 *a*). It is the only member of the genus and has the following characteristics: head fused with the first three thoracic segments and covered with a carapace as in the Caligidae; no lumules; fourth segment with a pair of dorsal plates, which overlap the genital segment and the basal segments of the fourth leg; genital segment in the female produced at each posterior corner into a curved process, carrying a serrated styliform appendage on its outer margin; in the male without processes, but with styliform appendages attached directly to its sides. Abdomen slender, 2-segmented; caudal rami filiform. First and fourth legs uniramose, second and third biramose, rami 3-segmented; terminal claws on first leg tripartite; furca compound, its branches bifid.

One copepod that seems to be specific for the swordfish was described by Steenstrup (1861) as *Philichthys xiphiae.* Linton (1899) and Wilson (1932) reported the parasite which is found free in the mucous canals of the head. These copepods are easily recognized by their external appearance. In the female the head is separated from the first segment and is small, rounded, without carapace; no neck; trunk elongated, narrowed posteriorly, and distinctly segmented, each segment being subdivided and all of them, including the head, have paired lateral and ventral processes which curve downward and inward. Anterior thorax swollen and orbicular, posterior portion cylindrical and tapered backward; abdomen short and segmented; no caudal rami. Antennae, mouth parts, swimming legs entirely absent. In the male the body is slender, cylindrical, segmented; head separated from the first segment, without a carapace; first and second thoracic segment as wide as the head, the others considerably narrower; abdomen made up of four segments; caudal rami elongate and cylindrical. First antennae 6-segmented; second antennae 2-segmented, each tipped with two claw-like spines; second maxillae stout and armed with strong spines; maxilliped small.

In his list of swordfish parasites, Goode (1880) mentions three species of copepods, two of which, *Pennella costaii* and *Brachiella remosa*, named by Richiardi, 1880, must remain as *nomen nudum* because no figures or descriptions were given. The third species, *Chondracanthus xiphiae* Guérin, which lives on the gills, was reported by Milne-Edwards (1840). The female members of this genus, according to Wilson (1932), have the following characters: head small, separated from the thorax by a constriction; first two segments free, rest of thorax fused with lateral knobs and dorsal laminae; legs uniramose, end segments boot-shaped.

CESTODA

PSEUDOPHYLLIDEA: *Dibothrium plicatum* Rudolphi

TETRARHYNCHIDEA: *Dibothriorhynchus attenuatus* (Rudolphi); *Tentacularia coryphaena* Bosc; *Nybelinia lamontei*, new species

NEMATODA

Contracaecum incurvum (Rudolphi)

COPEPODA

Pennella filosa Linnaeus

SUMMARY

One new and five previously described species of parasites were taken from the swordfish by the American Museum-Lerner Expedition at Louisburg, Nova Scotia, in the summer of 1936. These are as follows: Cestoda: PSEUDOPHYLLIDEA, *Dibothrium plicatum* Rudolphi; TETRARHYNCHIDEA, *Dibothriorhynchus attenuatus* (Rudolphi), *Tentacularia coryphaena* Bosc, *Nybelinia lamontei*, new species, Nematoda, *Contracaecum incurvum* (Rudolphi). Copepoda, *Pennella filosa* Linnaeus.

Other species of parasites from the swordfish reported in the literature are also discussed.

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HALICTINE BEES FROM MOROCCO

By T. D. A. Cockerell

The present paper completes the account of the *Halictus* of my 1930 expedition to Africa. At different times I have tried to identify the small black species described below, the holotypes of which will be found in the American Museum, but always without success, and I can only conclude that there is a strong endemic element in and about the Atlas Mountains, with no doubt many more species than are at present known.[1]

The species of *Halictus* reported from N. W. Africa are as follows; those which have metallic (green or blue) colors on head and thorax are marked (M).

A.—Species of the Canary Islands[2]
- *arctifrons* E. Saunders
- *chalcodes* Brullé (M)
- *concinnus* Brullé (M) (*microcardia* Pérez)
- *fulvipes* Klug
- *implicatus* Smith
- *laetus* Brullé (M)
- *villosulus* Kirby (not typical)
- *viridis* Brullé (M) (*alcedo* Vachal)
- *viridis unicolor* Brullé

B.—Species of the Madeira Islands
- *frontalis* Smith (*sepositus* Cockerell)
- *villosulus* Kirby (not typical)
- *wollastoni* Cockerell (M)

C.—Species of the Azores
- *malachurus* Kirby
- *morio Fabricius* (M)
- *villosulus* Kirby

It will be noted that the Canary Islands have six endemic species, and the Madeiras two; but all the species of the Azores are common European forms, and may well have been introduced.

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[1] Benoist, reviewing the *Osmia* of Morocco, had to describe twelve new ones. Alfken (1935) reported on a large collection of *Osmia* from Palestine. Nine were new, all different from Benoist's Morocco species.

[2] Bluthgen (Com. Biol., VI, 1937) states that *H. implicatus* Smith is a synonym of *H. viridis unicolor* Brullé, and adds to the Canarian Fauna (from Gomera) *H. brevicornis* subspecies *aciculatus* Blüthgen var. *gomerensis* Blüthgen, based on the male.

D.—Species of Morocco (CXXVIII and CLXVI refer to 'Descriptions and Records of Bees,' in Annals and Magazine of Natural History. 960 refers to American Museum Novitates, November, 1937).

albomaculatus Lucas (960)
angustifrons Vachal
asnicus Ckll. (960)
aureolus Pérez (M)
bequaerti Blüthgen (M)
brevicornis Schenck (infra)
callizonius Pérez (960)
capitalis Pérez (*mauretaniae* Strand)
cochlearitarsis Dours. (CXXVIII)
constantinensis Strand
costulatus Kriechbaumer (960) (*alpestris* Morawitz)
exetinus Ckll. (infra)
frigescens Ckll. (infra)
fulvipes Klug (CXXVIII) (*sexcinctellus* Dours.)
gemmeus Dours. (M) (CXXVIII)
ifranensis Ckll. (CXXVIII) (? = *intumescens* Pérez)
ifranicola Ckll. (960)
immunitus Vachal (*scariosus* Pérez)
indecisus Ckll. (infra)
interruptus Panzer (960)
interruptus atlanticus Ckll. (infra)
leucozonius Schrank (960)
lucidellus Ckll. (960)
lucidulus Schenck (CXXVIII)
maculipes ventralis Pérez
malachurops Ckll. (960)
malachurus Kirby (960)
malachurus sharificus Ckll. (960)
maroccanus Blüthgen
maurusius Blüthgen
mesoleus Ckll. (infra)
minutissimus Kirby (CXXVIII)
mogadoricus Ckll. (960)
morio Fabricius (M) (CXXVIII)
musculus Blüthgen
nadigi Blüthgen
optimellus Ckll. (infra)
orontis Ckll. (CXXVIII, as *H. platycestus*)
pauxillinus Ckll. (infra)
pauxillus Schenck (infra)
perminutus Ckll. (CLXVI)
phanerodontus Ckll. (CXXVIII)
pici Pérez (M) (*extorris* Vachal)
pollinosus Sichel (M) (CXXVIII)
pseudoleptocephalus Blüthgen (M)
punctatissimus Schenck
quadricinctus Fabricius
quadricinctus aegyptiacus Friese (CXXVIII)
rejectus Ckll. (960)
rufipes Fabricius (CXXVIII) (*formosus* Dours.)
rufotegularis Ckll. (infra)
rufulocinctus Ckll. (960)
scabiosae Rossi (CXXVIII)
scabiosae powelli Ckll. (CXXVIII)
smaragdulus Vachal (M)
sphecodimorphus Vachal
subauratus Rossi (M)
thevestensis Pérez (M)
tinitinensis Ckll. (CLXVI)
ultraparvus Ckll. (CLXVI)
vestitus Lepeletier (M) (CXXVIII)
villosulus Kirby
villosulus perlautus Ckll. (CLXVI)
virens Erichson (M)

Halictus pauxillus Schenck

Morocco: Tangier, August 1, ♀ (Cockerell). Compared with specimens from St. Helens, I. of Wight, and Wangen, Baden, the head is smaller, and the front more shining. Blüthgen recorded male *H. pauxillus* from El Hajeb, remarking that it was not typical. Probably a distinct race should be recognized, but more material is needed.

Halictus (Evylaeus) frigescens, new species

FEMALE.—Length about 5.7 mm., anterior wing 4.7 mm.; black, shining, with scanty grayish-white hair. Head broad, circular seen from in front; clypeus rather prominent, polished, with widely scattered punctures; sides of face and front shining, but middle of front with excessively dense minute punctures, running in rows; flagellum obscurely reddish beneath. Mesothorax and scutellum polished, disc of mesothorax with sparse but distinct punctures, mostly running in rows; area of metathorax very large, appearing dull and little sculptured under a lens, the hind margin thickened; the microscope shows widely separated very delicate irregular vermiform rugae, not reaching the hind margin (*H. pauxillus* has much stronger, denser rugae); posterior truncation sharply defined all round; tegulae light rufo-testaceous. Wings iridescent, faintly grayish; stigma very large, dusky reddish (in *H. pauxillus* pale dull yellowish); nervures pale, first recurrent joining second cubital cell near end. Legs black, the small joints of tarsi pale red, and the hind tibiae and tarsi distinctly brown; hind spur serrate, not spined. Abdomen broad, shining, with the hind margins of tergites conspicuously pallid; dull whitish tomentum at sides of bases of second and third tergites; first tergite with excessively minute punctures (only seen under microscope), not at all dense; second with dense minute punctures; venter with long white hair.

Morocco: Mogador, August 19, at flowers of white daisy (Cockerell). This agrees with no species recorded from Morocco or Algeria. In Blüthgen's table of Spanish species it runs straight to *H. pauxillus*, agreeing best with the vernal form *immarginatus* Schenck (*similis* Schenck). But it is readily distinguished from *H. pauxillus* by the sculpture of the metathorax, the color of the stigma, and other characters. The orbits strongly converge below, instead of being parallel as in *H. capitalis* Pérez. The specific name chosen is in allusion to the climate of Mogador.

Halictus interruptus atlanticus, new subspecies

In addition to a female from Ifrane, I have two males from Asni, Morocco, August 8 and 9 (Cockerell). Blüthgen (1923) recorded what must have been the same insect from Asni as *H. interruptus opacus* (Pérez). I have three females of *H. opacus* received from Pérez, two from Corsica and one from Sicily. On account of the dense punctures of the first tergite, they certainly have the aspect of a distinct species, but they agree with *H. interruptus* in the reddened wings. The insect from Morocco has the wings grayish in the female, clear hyaline in the male, not at all reddened. The first tergite has extremely dense small punctures in middle, and large well-separated punctures at sides. The sculpture of the area of metathorax is more delicate than in *H. opacus*, and the tegulae are much redder. It is evident that the insect from Morocco (taking the Ifrane female, collected by Miss Mackie, as the type) represents a distinct race. Pérez described his *H. opacus* in his paper (1895) on the bees of Barbary, but gave no locality. His description agrees with the specimens he sent to me, and I assume that these are the genuine *H. opacus*, or *H. interruptus opacus* as Blüthgen has it. My males run exactly to *H. interruptus* in Blüthgen's table of Spanish *Halictus*, and Hedicke's German table.

Halictus brevicornis Schenck

Morocco: Ifrane, August 29, male (A. Mackie). Exactly agrees with one from Argentat (Vachal).

Halictus mesoleus, new species

MALE.—Length about 6 mm., anterior wing 5 mm.; black. The head broad, circular seen from in front, face and front covered with white hair; clypeus with the lower part very broadly yellow; labrum yellow; mandibles pale yellowish; front dull, but a shining depression in front of ocelli; flagellum clear ferruginous beneath, moderately long, about reaching scutellum. Mesothorax shining but very distinctly punctured; scutellum shining; area of metathorax with fine regular parallel plicae, the hind margin thickened, with a shining spot in middle; posterior truncation shining, sharply bordered at sides; mesopleura dull; tubercles pale at end; tegulae pellucid reddish. Wings hyaline, faintly grayish; stigma dull pale fulvous, with a dark margin; nervures pale; second cubital cell rather narrow. Legs black at base, but the tibiae pale, somewhat reddish, with a large dark patch, in the case of the middle tibiae, seen from without, only the ends are pale; tarsi cream-colored becoming a little rufescent apically. Abdomen convex, highly polished, the margins of the tergites dark; no evident hair-bands or spots, but there is a very little pale hair, hardly noticeable, at sides of bases of second and third tergites; fifth sternite finely pruinose-pubescent, broadly and deeply emarginate, sixth smooth and shining. The first tergite, as seen under the microscope, has strong sparse punctures, but in the middle of the disc is a large smooth area, with hardly any punctures.

Morocco: Ifrane, August, 1930 (Alice Mackie). In some respects this resembles *H. quadrisignatus* Schenck, but that has a black clypeus. The comparatively broad, white-hoary face suggests *H. villosulus* Kirby, but the orbits converge more below than in that species, and the yellow on clypeus is distinctive. In Blüthgen's Spanish table it runs near *H. interruptus*, which is quite different. There is no distinct median groove on mesothorax, such as there is in *H. ventralis* Pérez. There is a general resemblance to *H. mandibularis* Morawitz, but the abdomen is quite different.

Halictus (Evylaeus) exetinus, new species

MALE.—Length about 5 mm., anterior wing 4 mm.; black, with scanty whitish pubescence, only moderately dense on face and front, the clypeus and supraclypeal area exposed. Head broad-oval, with the clypeus distinctly produced; supraclypeal area shining; clypeus well punctured, its lower margin narrowly yellow; labrum yellow; mandibles mainly yellow, with the end red; antennae long, reaching beyond scutellum, the flagellum pale dusky red (not at all brightly colored) beneath. Mesothorax shining, but quite closely and strongly punctured, the median groove distinct; scutellum shining; area of metathorax dull, with an obtuse thickened shining posterior margin; posterior truncation not sharply bounded at sides; tegulae rufofulvous. Wings hyaline, faintly dusky; stigma large, entirely red, without a dark margin; nervures pale; second cubital cell greatly narrowed above; first recurrent nervure meeting intercubitus; the oblique sides of third cubital cell nearly parallel. Legs black, with the small joints of tarsi dusky red, and a red spot on front knees. Abdomen moderately shining, distinctly and closely punctured, perhaps with a faint greenish tint, without hair-bands or spots. Microscopical characters: front extremely densely punctured; punctures of mesothorax well separated on a shining surface; area of metathorax with only feeble imperfect plicae; first and second tergites closely punctured, the punctures running largely in rows.

Morocco: Asni, August, 1930 (W. P. Cockerell). *H. maurusius* Blüthgen has the long face, but is a much larger species. There is some resemblance to *H. hollandi* E. Saunders, but that has the mesothorax minutely rugulose, and also differs by having the apices of first and second tergites deeply impressed. The species is not in Blüthgen's paper on the *Halictus* of Spain, nor in Hedicke's table of central European *Halictus*, and I find no other description to fit it.

Halictus (Evylaeus) indecisus, new species

FEMALE.—Length about 5.5 mm., anterior wing 4.3 mm.; black, robust, with scanty whitish hair, rather long and abundant on sides of thorax below; abdomen without distinct hair-bands or spots, a little pale pubescence at sides of base of second tergite. Head broad-oval, the clypeus moderately produced; mandibles reddened at tip; flagellum faintly brownish beneath; supraclypeal area large, shining; clypeus strongly punctured; front dull. Mesothorax shining, but strongly and rather closely punctured; scutellum closely punctured; area of metathorax with more than the basal half covered with dense parallel plicae, the part beyond shining; posterior truncation dullish, distinctly defined at sides except above; tegulae very dark, practically black. Wings grayish; stigma dark dusky reddish, nervures pale; second cubital cell very narrow on marginal; first recurrent nervure meeting intercubitus. Legs black, with white hair, pale yellowish on inner side of hind tarsi; spurs pale red. Abdomen broad, shining, hind margins of tergites not pallid; the fourth and fifth tergites have thin pale hair on lateral margins. Microscopic characters: clypeus and supraclypeal area strongly punctured; front very densely punctured, not striate; first tergite with fine rather dense punctures, failing in basal middle of disc; hind spur with four rather short oblique spines.

Morocco: Asni, August 10, 1930 (W. P. Cockerell). There is some resemblance to *H. gracilis* Morawitz, but that is much smaller, with quite different tegulae. *H. intermedius* Schenck is similar, but our species has a narrower face, and much more strongly punctured mesothorax.

Halictus (Evylaeus) optimellus, new species

FEMALE.—Length about 6.3 mm., anterior wing 5 mm.; black, robust, with thin grayish-white hair, conspicuous on sides of thorax. Head broad, but suboval, not circular; mandibles faintly reddish apically; clypeus moderately produced, well punctured; supraclypeal area highly polished; front dull, a shining band along inner orbits; apical part of flagellum red beneath; mesothorax shining, with inconspicuous punctures; scutellum shining; area of metathorax dull, rugulose, but the thickened hind margin shining; posterior truncation with the upper part shining, the sides not sharply defined; tegulae rufous. Wings hyaline, the large stigma pale testaceous with a dark margin; nervures pale; second cubital cell moderately broad above; first recurrent nervure meeting intercubitus; third cubital cell large, its outer side strongly arched. Legs black, with small joints of tarsi rufous, spurs whitish. Abdomen moderately shining, without hair bands or spots, but much white hair on apical portion, the caudal furrow red; hind margins of second and following tergites pallid. Microscopic characters: supraclypeal area with minute widely scattered punctures; front very densely punctured, some minute cross-striation on lower part; disc of mesothorax with minute sparse punctures; plicae of area of metathorax connected by minute cross-striae; punctures of disc of first tergite excessively weak and sparse; hind spur very long, with six widely spaced oblique spines, but the last ones quite rudimentary.

Morocco: Ifrane, August, 1930 (Cockerell). Resembles *H. hellenicus* Blüthgen, having the same sort of stigma, but *hellenicus* has a much broader head. In the Spanish table it appears to run near *H. minutulus* Schenck, which has a smaller, quite different stigma, and does not have the shining apical margin of basal area of metathorax.

Halictus (Evylaeus) pauxillinus, new species

FEMALE.—Length about 5.5 mm., anterior wing 5 mm.; black, robust, with very scanty whitish hair, not forming distinct bands or spots on abdomen. Head broad, circular seen from in front, the clypeus short, not produced; mandibles faintly reddish apically, the sharp inner tooth far from end; flagellum obscurely brown beneath. Mesothorax shining, the disc with distinct but well-separated punctures, median groove distinct; scutellum shining, but postscutellum entirely dull, in strong contrast; area of metathorax large, crescentic, sculptured all over, a little shining in certain lights, the posterior margin not shining; posterior truncation shining, not sharply defined at sides; tegulae very dark, almost black. Wings hyaline, faintly dusky; stigma pale dull testaceous; nervures pale; second cubital cell nearly as broad on marginal as third; first recurrent nervure meeting intercubitus. Legs black, with dull white hair, small joints of tarsi brownish; spurs white. Abdomen broad, moderately shining, the hind margins of third and fourth tergites narrowly pallid, much white hair in apical region, a little pale pubescence at sides of base of second tergite. Microscopic characters: tongue very short; punctures of mesothorax strong and well separated on disc; area of metathorax with distinct plicae from base to apex, in the middle third connected by little branches, forming an irregular reticulation; disc of first tergite with excessively weak widely scattered punctures, but the marginal area is distinctly punctured; tegulae minutely punctured on basal part only; hind spur with four short oblique teeth.

Morocco: Ifrane, August 26, 1930 (Alice Mackie). In Hedicke's table this runs nearest to *H. quadrisignatus* Schenck, which has a much darker stigma and much more coarsely sculptured area of metathorax. I cannot place it anywhere in Blüthgen's Spanish table, nor identify it with anything described from N. Africa. The stigma and metathorax suggest *H. pauxillus* Schenck, but that has the margins of the tergites pallid. At first I thought this might be the female of *H. exetinus*, but there are too many differences in details.

Halictus (Evylaeus) rufotegularis, new species

FEMALE.—Length about 7 mm., anterior wing 5.5 mm.; black, rather elongated, with dull white hair, long and conspicuous about bases of antennae, region of scutellum, and under side of thorax. Head broad, circular seen from in front; clypeus shining, strongly punctured; supraclypeal area dullish, not elevated, closely punctured; front dull, narrowly shining along orbits; mandibles black; flagellum reddened at apex beneath. Mesothorax and scutellum highly polished, with fine sparse punctures on disc; area of metathorax crescentic, shining, with very strong plicae, the apical margin shining; tegulae large, red with a hyaline margin. Wings hyaline; stigma large, uniform red-brown; basal, marginal, and other nervures dark, but in central part of wing the nervures are very light, the outer recurrent and intercubitus hard to see. Legs black, with the small joints of tarsi reddened; hind tibiae with dense pure white hair. Abdomen shining, the first tergite highly polished, and appearing impunctate under a lens; there are no distinct hair-bands or patches, but thin white pruinose pubescence on third and following tergites, and long white hair at sides of fourth; apex with white hair; venter with a curled polliniferous scopa. Microscopic characters: mesothorax with large punctures on a smooth surface, and some extremely minute punctures between; hind spur with short sharp teeth.

Morocco: Ifrane, August 27, 1930 (Alice Mackie). *H. transitorius* Schenck (*planulus* Pérez) is allied, but our species is larger, with much broader head and different metathorax. The stigma is like that of *H. quadrisignatus* Schenck, but the abdomen and metathorax are different. In *H. quadrisignatus* the area of metathorax is shorter, very coarsely sculptured, and hardly shining. Compared with *H. indecisus*, this species is not only larger, but has the marginal cell notably longer in proportion.

The following key to small *Halictus* of Morocco, having black head and thorax, will facilitate identification.

1.—Females..2.
Males..14.
2.—With bands of white felt at bases of tergites 2 and 3..........3.
Without such bands..4.
3.—Clypeus produced; sides of face polished; tegulae all dark.
mogadoricus Cockerell.

Clypeus not produced; sides of face not polished; tegulae red on outer side. *interruptus* Panzer, *sens. lat.*
4.—Mesnotum dull; tegulae mostly dark..5.
Mesonotum polished..8.
5.—Head oval..6.
Head broader..7.
6.—Hind margin of first tergite narrowly red; median sulcus of mesonotum deep. *tinitinensis* Cockerell.
Hind margin of first tergite not red; sulcus of mesonotum weak. *indecisus*, n. sp.
7.—Larger, about 7.5 mm. long; weak bands on apices of tergites; stigma very pale................................*malachurus* Kirby, *sens. lat.*
Smaller; not nearly so hairy....................*pauxillus* Schenck, *sens. lat.*
8.—Area of metathorax dull, not distinctly plicate; mostly very small species....9.
Area of metathorax distinctly plicate; none very small..................11.
9.—Stigma pale yellowish: wings appearing milky and iridescent. *pauxillinus*, n. sp.
Stigma brown..10.
10.—Larger, fully 6 mm. long................................*frigescens*, n. sp.
Very small................................*lucidulus* Schenck.
11.—Head rather narrow, clypeus produced; apical half of abdomen coarsely hairy................................*optimellus*, n. sp.
Head round; apical half of abdomen not thus hairy.................. 12.
12.—Area of metathorax shining, the plicae very strong........*rufotegularis*, n. sp.
Area of metathorax dull, except on margin..............................13.
13.—Area of metathorax with a thick shining margin, depressed in middle, the apical part polished..............................*villosulus* Kirby, *sens. lat.*
Area of metathorax without such margin, the plicae going to margin. *villosulus* Kirby, *sens. lat.*
14.—Abdomen largely reddish....................*malachurus sharificus* Cockerell.
Abdomen black, or in small part reddish..............................15.
15.—Extremely minute, with light mark on clypeus; flagellum red beneath......16.
Not thus minute..17.
16.—Flagellum very long................................*asnicus* Cockerell.
Flagellum shorter; mesonotum with a strong sulcus....*ultraparvus* Cockerell.
Flagellum shorter; mesonotum without sulcus; head oval. *perminutus* Cockerell.
17.—Clypeus with no light mark..18.
Clypeus with a light mark..19.
18.—Stigma very large, reddish........................*villosulus* Kirby, *sens. lat.*
Stigma smaller and paler........................*villosulus* Kirby, *sens. lat.*
19.—Flagellum clear bright red beneath..20.
Flagellum dusky or dark..24.
20.—Bands of white tomentum at bases of second and third tergites. *interruptus atlanticus*, n. subsp.
No such bands..21.
21.—Smaller, with black hind tibiae; mesothorax shining.....*brevicornis* Schenck.

Larger, hind tibiae largely pale; hind margins of tergites pallid; mesonotum with anterior half dull..22.

22.—Abdomen without red..........................*malachurus* Kirby, *sens. lat.*

Abdomen with some red...23.

23.—Second tergite red, with a black band.
malachurus sharificus Cockerell, variety.

Second tergite black, with a transverse red mark.
malachurus sharificus Cockerell, variety.

24.—No bands of white tomentum at bases of tergites........................25.

Bands of white tomentum at bases of tergites..............................26.

25.—Hind margins of tergites reddened..................*rufulocinctus* Cockerell.

Abdomen all black..*exetinus*, n. sp.

26.—Flagellum brown beneath; rather slender species........*leucozonius* Schrank.

Flagellum black; tubercles black.....................................27.

27.—Wings very long, with dusky suffusion; mesonotum polished and strongly punctured..................................*costulatus* Kriechbaumer.

Wings not so, no dusky suffusion; thorax extremely hairy....*callizonius* Pérez.

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NOTES ON CARANGIN FISHES

III.—ON *CARANX SEXFASCIATUS* QUOY AND GAIMARD

BY J. T. NICHOLS

The form of the genus *Caranx* with completely scaled breast, most closely related to the *C. hippos–ignobilis* group wherein the breast has only a central patch of scales, is at present generally referred to *Caranx sexfasciatus* Quoy and Gaimard. It has banded young similar to the type figure thereof; and this identification is reasonably satisfactory, and accepted by the writer. Weber and de Beaufort, 1931, 'Fishes Indo- Aust. Archipel.,' VI, pp. 243 to 246, give an extensive synonymy of this species in the Indo-Pacific, in which the writer concurs in the main. They do not recognize its variations or races, including what seems to be the best marked of these (*C. s. elacate*) without comment.

Caranx sexfasciatus is then a circumtropical form characterized by a curved front profile of the head, much enlarged scutes on the peduncle, and deep-bodied banded young like the *hippos* group. Like these it has differentiated canines in the front of the jaws, but smaller, sometimes quite small. I take the view that it is as or more closely related to this group than to any other member of the genus, and that hence a distinct genus cannot advantageously be based on their scaleless breast with central patch of scales, which is sometimes done.

Caranx sexfasciatus differs from the *hippos–ignobilis* group in the fully scaled breast and somewhat more abrupt and relatively shorter curved part of the lateral line. It loses any comparable black opercular blotch (conspicuous in *hippos*) at an early age, but frequently develops a small black fleck about the very upper end of the gill-slit. The end of the lobe of the soft dorsal almost invariably becomes black or dusky, and there is no corresponding mark on the anal though this fin as a whole may be dark colored. The scutes or keels commonly become darker than the area above and below and show as a dark stripe. It is a rather easy form to recognize if one is thoroughly familiar with its characters, very easy to confuse with a variety of other forms if one is not, frequently mis-identified, and has been frequently named.

RACES

Caranx sexfasciatus varies more or less geographically over its wide range as is shown by material in The American Museum of Natural History, mostly into poorly defined races, in one case at least, into what may be a tenable species. The race with which I am most familiar is the "horse-eyed jack" of the Bahamas, abundant in Bermuda, not plentiful in Florida and uncommon on our coast north of there, seemingly a fish of the West Indian fauna, more or less replaced on continental North American shores by related *Caranx hippos*. It is generally known as *Caranx latus* Agassiz (1829) with type locality Brazil; and *Caranx fallax* Cuvier and Valenciennes (1833), Antilles, Brazil,—Poey (1875), Cuba, is also available for it. It is characterized by great depth of body and large eye at moderate sizes, holding both these characters of youth longer than most members of the genus do.[1] At a large size it becomes more slender, however, one of some 950 mm. having depth about 3.4.[2] In 11 specimens from Porto Rico and Nassau the dorsal soft rays are 21, anal 16 to 18 (average 16.7).

A specimen of presumably typical *C. s. sexfasciatus* from New Guinea (Archbold collections) 130 mm. in standard length, fits into our West Indian series except that there are but 20 dorsal and 16 anal soft rays, few scutes (31), and its canines are perhaps a little more prominent. Weber and de Beaufort, presumably from East Indian material, give dorsal soft rays as 19 to 22; anal, 15 to 17; scutes, 30 to 33.

Six specimens of 82 to 154 mm. from Rio de Janeiro, Brazil (Morden collections) have dorsal soft rays 20 to 23 (average 21.2), anal 16 to 17 (average 16.5). They fit the West Indian series except that the eye becomes too small (4 in head) at from 128 to 154 mm. standard length. At Rio this seems to be the common shore *Caranx*, probably fitting a somewhat different ecological niche from the West Indian fish. If we wish to differentiate it, it may stand as *Caranx sexfasciatus latus* Agassiz, the latter as *Caranx sexfasciatus fallax* Cuvier and Valenciennes. According to Meek and Hildebrand's description this species on the Atlantic coast of Panama matches *fallax* rather than *latus* though perhaps somewhat intermediate.

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[1] Nichols, 1937, Amer. Mus. Novitates, No. 967, p. 3.
[2] Nichols, 1912, Bull. Amer. Mus. Nat. Hist., XXI, p. 186.

Two specimens of 84 and 115 mm. standard length from Ecuador (Morden collections) have the eye, respectively, 3.5, 3.8; dorsal soft rays, 18, 20; anal, 15, 15; scutes, 28, 31. These are presumably referable to *Caranx sexfasciatus marginatus* Gill (1866), characterized by a minimum number of fin rays; in these specimens differing but slightly from *C. s. latus* (above), that is in this character and in fewer scutes. The scutes in a combined series of 17 *latus* and *fallax* (above) vary from 28 to 38, but average 33.3$^1/_2$.

Meek and Hildebrand, 1925, 'Fishes Panama,' Field Mus. Nat. Hist., Zool., XV(pt. 2), p. 356, give dorsal soft rays as 19 to 20; anal, 15 to 17; scutes, 25 to 30. The difference of shape figured (Pl. xxvi) between this and a specimen of the Atlantic form is largely an age difference. The diagnostic enlarged peduncular scutes do not show as they should in their figure of the larger specimen (*marginatus*).

Five specimens of 44 to 335 mm. from the Hawaiian Islands (Morden collections) are notable for the particularly great breadth of scutes on the peduncle, and comparatively few scutes, 25 to 29 (average 26.2). Ordinarily somewhat fewer scutes are appreciable in smaller than in larger fish, and the relative breadth of the peduncular scutes increases with size. In this form the latter tendency very likely crowds out some of the smaller scutes, keeping the total number consistently low. The dorsal soft rays are 19 to 20 (average 19.4), anal 16 to 17 (average 16.2). The eye remains as large as that of *fallax*, at least to a standard length over 100 mm., but over 100 mm. the depth falls off more rapidly, the fish is more slender. This is *Caranx sexfasciatus elacate* (Jordan and Evermann, April, 1903), of which *Carangus rhabdotus* Jenkins (September, 1903) is presumably the young. The type of *elacate*, some 675 mm. in (? total) length, had dorsal soft rays, 19; anal, 16; scutes, 28; depth in length, 3.4; eye in head, 4.5.

Applying this evidence, such as it is, to *Caranx sexfasciatus* considered one widely ranging variable form, we have slightly more fin rays and scutes in the Atlantic; the eye less large (decreasing more normally with growth of fish) on coasts of Brazil and Ecuador; body less deep (depth decreasing more normally), and scutes larger (posteriorly) and fewer, about the isolated Hawaiian Islands. West Indian *fallax* is barely distinguishable from East Indian *sexfasciatus*, and differs appreciably in habitus from Brazilian *latus*, which averages higher fin and scute counts than West Coast *marginatus*. All these differ so little as to be questionably recognizable, but Hawaiian *elacate* is more distinct.

A tentative key to differentiate specimens between 100 and 200 mm. standard length might read:

(1) Scutes, 25 to 30; depth, 2.7 or more in length; eye, 3.7 or less in head; average dorsal and anal soft rays, 19.4, 16.2........................*elacate.*
Scutes, 30 to 38; depth, 2.7 or less in length....................See (2).
(2) Eye (at 125 or more mm.), 3.8 or more in head....................See (3).
Eye, 3.7 or less in head..See (4).
(3) Average dorsal soft rays, 21.2; anal, 16.5; scutes, 34.7................*latus.*
Average dorsal soft rays, 19; anal, 15; scutes, 29.5...............*marginatus.*
(4) Average dorsal soft rays, 21; anal, 16.7; scutes, 32.6................*fallax.*
Dorsal soft rays about 20; anal, 16; scutes, 31..................*sexfasciatus.*

COLOR

I have noted that in a mixed school of moderate-sized (perhaps 100 to 300 mm.) *Caranx* swimming in an aquarium tank (Florida, February, 1921), "the big eye of *latus* [*C. s. fallax*] was noticeable, as also its yellow, dark rimmed caudal, and black dorsal lobe."

Detailed color notes were made on a specimen of about 275 mm. standard length when fresh from the Nassau market as follows: "Dark gray above, silvery on sides, white on belly; dull greenish and slightly brassy reflections on back and sides, bluish, pinkish and greenish ones on lower parts. Iris silvery, tinged with reddish gold and with a narrow reddish inner ring; an obscure dusky blotch on margin of opercle bordered in front with brassy, and a small dusky mark at extreme upper end of gill opening; tip of scutes dusky, making a rather conspicuous dusky streak. Spinous dorsal pale; soft dorsal light gray; caudal gray tinged with yellow; end of dorsal lobe and margin of caudal, which were probably blackish, frayed off. Anal gray, anterior rays, distal end of lobe, and very narrow basal and marginal line, whitish; ventrals white; pectoral pale, with a clouded dusky blotch at base below the center. Tip of lower jaw dusky. The blotch on gill-cover and base of pectoral less bold and different in character and position from corresponding marks in *hippos.*" A specimen of about 143 mm. had "caudal grayish yellow with black margin; soft dorsal broadly tipped with black."

According to Weber and de Beaufort *C.* [*s.*] *sexfasciatus* has "Colour in young bluish, later brownish above, lighter below; in young till about 80 to 100 mm. length crossed by 5–7 broad dark bands, disappearing later on, the first crossing the eye; in young the spinous dorsal and the lobe of the soft dorsal blackish, all other fins yellowish, in adult the dorsal, anal and caudal more or less blackish, the paired fins light; . . . Length till about 1000 mm."

Specimens of *C. s. elacate* of 45 to 90 mm. standard length are (when freshly preserved) rather dark olive above, more or less silvery below, the dark bars on the sides becoming broader and more indistinct in the larger separated by narrow pale interspaces, the end of the dorsal lobe and sometimes the margin of the fin dusky or blackish, the caudal becoming gray darkening toward its margin. At a corresponding size their color is quite unlike that of *C. melampygus*, the related Hawaiian form with which they might be confused. A specimen of the latter of 84 mm. is bright silvery above and below, tips of soft dorsal and anal lobes slightly dusky. A *C. s. elacate* of 116 mm. has completely lost the bars and is brownish above, silvery below, the line of the peduncular keels slightly dusky, the anal still pale. One of 335 mm. (in alcohol some time) is lead color above, the sides and below dull, rather brassy yellow; the scutes dusky gray; dorsal, caudal, and anal rather dark, the lobe of the dorsal darker. The type, a larger fish of 500 or 600 or more mm. (whether length standard or total not stated) is described by Jordan and Evermann as olivaceous, paler on the lower sides and white on the belly, with vertical fins all more or less dark, and is figured with blackish scutes.

Two (freshly preserved) *C. s. marginatus* of 84 and 115 mm. had end of dorsal lobe black, margin of fin and margin of caudal within the fork somewhat dusky, and the anal pale. The smaller had 5 dark bands on the back and sides behind the head and was silvery below, the larger was olive-gray above, silver-white below.

According to Meek and Hildebrand this form is bluish above, sides silvery, young with 5 or 6 dark cross-bars, and they figure a specimen 105 mm. long (? total) with the bars distinct. Bars are presumably lost at about 100 mm. or a little more standard length in this form and in *elacate*. Jordan and Evermann (1896, Bull. U. S. Nat. Mus., XLVII, pt. I, p. 923) give the colors as bluish, sides golden.

Specimens of *C. s. latus* of 82 and 88 mm. standard length from Rio (freshly preserved) had about 5 broad dark bands indicated on the upper sides, separated by narrow paler interspaces, in another of 89 mm. there were only faint traces of bands, and 3 of 113 to 154 mm.

lacked them altogether and were paler, greenish gray above, silvery white below. There was a slight spot in the upper notch of the gill cleft in one of 128 mm., more distinct in the largest of 154 mm. which was also slightly dusky along the peduncular keels. All had a sharp black end to the dorsal lobe and slight dusky edging in the caudal angle.

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THE TYPES OF LEPIDOPTERA DESCRIBED BY J. D. GUNDER

BY CYRIL F. DOS PASSOS

This is the fourth of a series of papers on the types of Lepidoptera in the collection of The American Museum of Natural History.[1]

During the winter of 1936–1937 the American Museum purchased the collection of North American Lepidoptera, mostly Rhopalocera, made by J. D. Gunder of Pasadena, California. This collection contained 171 out of 212 types described by Gunder as well as 50 types of other authors. It was also very rich in aberrations, sometimes called "transition forms" (tr.f.) there being about 941 of these and about 27,000 other specimens, mostly taken west of Denver, Colorado. It is one of the largest and most valuable additions to the collection of Rhopalocera since the acquisition of the Henry Edwards collection.

The following pages list all of Gunder's types whether received by the Museum or not, the latter fact being indicated by an asterisk (*). A few types have not yet been located in the collections and these are indicated by a dagger (†). A reference is also given to the original description, the type locality, the collector's name, the type series and the disposition of the type when it is not in the Museum collection.

The list follows, in most cases, the arrangement of the Barnes and Benjamin Check List (1926, Bull. So. Calif. Acad. Sci., XXV, p. 31).

Papilionidae

Papilio philenor hirsuta tr.f. **inghami**.—1927, Ent. News, XXXVIII, p. 268, Pl. A, figs. E, E1. Fairfax, California (Chas. Ingham).

Holotype ♀, June 6, 1924.

Papilio zelicaon tr.f. **mcdunnoughi***.—1928, Can. Ent., LX, p. 162, Pl. A, figs. 1, 1a. Waterton Lakes, Alberta, Canada.

Holotype ♂, June 29, 1923, Can. Nat. coll. Paratypes: ♂, Big Horn Mts., Wyoming, Aug. 19, 1927, coll. John Garth; ♂, Colorado (Bruce), no date, coll. Strecker.

Gr [illegible]
1892, [illegible] Collection of Insects,' by William Beutenmuller, 1892, Bull. Amer. Mus. Nat. Hist., IV, pp. 167–198; 'Types of Lepidoptera in The Collection of The American Museum of Natural History,' by William Beutenmuller, 1904, Bull. Amer. Mus. Nat. Hist., XX, pp. 81–86.

Papilio cresphontes tr.f. **forsythae.**—1933, Can. Ent., LXV, p. 171. Florida City, Florida (bred by Mrs. L. E. Forsyth).
Holotype ♂, Nov. 21, 1931; allotype ♀, Dec. 4, 1931.

Papilio glaucus f. **turnus** tr.f. **dietzi*.**—1927, Ent. News, XXXVIII, p. 266, Pl. v, fig. A. Van Cortland Park, New York (H. Dietz).
Holotype ♀, June 26, 1910, coll. H. Dietz.

Papilio glaucus f. **turnus** tr.f. **gerhardi*.**—1927, Ent. News, XXXVIII, p. 266, Pl. v, fig. B. Evansville, Indiana (Evans).
Holotype ♂, no date, coll. Strecker.

Papilio rutulus tr.f. **fannyae.**—1927, Ent. News, XXXVIII, p. 267, Pl. v, fig. C. Yoncalla, Oregon (Rees).
Holotype ♂, June 10, 1926.

Papilio eurymedon f. **albanus** ab. ♂ **cocklei.**—1925, Ent. News, XXXVI, p. 200, Pl. v, fig. 12. Kaslo, B. C.
Holotype ♂, May 24, 1924.

Papilio eurymedon f. **albanus** tr.f. **columbiana.**—1927, Ent. News, XXXVIII, p. 267, Pl. v, fig. D. Kaslo, B. C. (Cockle).
Holotype ♂, June 28, 1925.

Papilio marcellus tr.f. **broweri*.**—1927, Ent. News, XXXVIII, p. 269. Willard, Mo. (Brower).
Holotype ♂, June 23, 1918, coll. U. S. Nat. Mus.

Parnassius eversmanni (race **thor**?) tr.f. **kohlsaati.**—1932, Pan. Pac. Ent., VIII, p. 123. McKinley Nat. Park, Alaska (Frank Morand).
Holotype ♂, June 27, 1931.

Parnassius clodius baldur ab. ♂ **binigrimaculella.**—1926, Ent. News, XXXVII, p. 8, Pl. I, fig. 13. Gold Lake, Sierra Co., California.
Holotype ♂, July 14, 1922.

Parnassius clodius tr.f. **dodgei.**—1932, Pan. Pac. Ent., VIII, p. 123. Santa Cruz Hills, Santa Cruz, California.
Holotype ♂, June 15, 1923.

Parnassius clodius baldur tr.f. **sulfureus.**—1932, Pan. Pac. Ent., VIII, p. 124. Davis Cr., Modoc Co., California.
Holotype ♂, June 12, 1924; allotype ♀, June 18, 1924.

Pieridae

Pieris napi castoria ab. ♂ **cottlei.**—1925, Ent. News, XXXVI, p. 197, Pl. v, fig. 9. Anderson Springs, Lake Co., California.
Holotype ♂, May 5, 1919.

Anthocharis sara tr.f. **corcorani.**—1931, Bull. So. Cal. Ac. Sci., XXX, p. 45. Griffith Park, Los Angeles, California.
Holotype ♀, April 14, 1931.

Anthocharis sara f. **reakirti** ab. ♂ **sternitzkyi.**—1925, Ent. News, XXXVI, p. 4, Pl. I, fig. Q. San Francisco, California.
Holotype ♂, April 22, 1924.

Anthocharis sara reakirtii, tr.f. **broweri.**—1932, Pan. Pac. Ent., VIII, p. 124. Peanut Hill, Berkeley Hills, Alameda Co., California.
Holotype ♂, March 14, 1928.

Anthocharis sara julia tr.f. sulfuris.—1931, Bull. So. Cal. Ac. Sci., XXX, p. 45. Kellogg, Idaho.
Holotype ♂, June 1, 1931.

Anthocharis sara reakirtii f. flavicoloris.†—1933, Pan. Pac. Ent., IX, p. 151. Tocaloma, Marin Co., California (Sternitzky).
Holotype ♂, March 12, 1926; allotype ♀, March 22, 1930, Berkeley, California; 2 ♂ paratypes from San Francisco Bay region; 2 ♀ paratypes, March, Los Angeles area.

Anthocharis sara inghami.—1932, Can. Ent., LXIV, p. 276. Tucson, Arizona.
Holotype ♂, March 9, 1929; allotype ♀, March 18, 1928; paratypes, 6 ♂ and 1 ♀, March 20–April 2, 1932, Globe, Arizona and vicinity (D. K. Duncan).

Anthocharis sara inghami tr.f. duncani.—1932, Can. Ent., LXIV, p. 277. Globe, Arizona.
Holotype ♂, March 21, 1932.

Anthocharis sara alaskensis.—1932, Can. Ent., LXIV, p. 277. Skagway, Alaska (Shoemaker).
Holotype ♂, May 29, 1925; allotype ♀, June 2, 1925.

Zerene eurydice ab. ♂ **fanniae.**—1924, Ent. News, XXXV, p. 158, Pl. ii, fig. K. San Bernardino Mts., San Bernardino Co., California.
Holotype ♂, July 6, 1922.

Zerene eurydice f. ♂ **lineainita.**†—1928, Pan. Pac. Ent., IV, p. 101, Pl. i. San Bernardino Mts., California.
Holotype ♂, July 3, 1924.

Zerene eurydice f. ♀ **masumbrosus.**—1928, Pan. Pac. Ent., IV, p. 100, Pl. i, fig. 3. California.
Holotype ♀, coll. Hy. Edwards.

Zerene eurydice tr.f. doudoroffi.—1932, Pan. Pac. Ent., VIII, p. 125. Lake Alpine, Fairfax, Marin Co., California.
Holotype ♀, July 17, 1929.

Zerene eurydice ab. ♂ **newcombi.**—1925, Ent. News, XXXVI, p. 4, Pl. i, fig. R. San Bernardino Mts., San Bernardino Co., California.
Holotype ♂, no date.

Zerene caesonia f. ♀ **immaculsecunda.**—1928, Pan Pac. Ent., IV, p. 102, Pl. ii. Pinery Canyon, Arizona.
Holotype ♀, Sept. 23, 1927; paratype ♀, Willard, Mo. (Brower), Sept. 27, 1917.

Eurymus meadii f. ♀ **medi.**– 1934, Can. Ent., LXVI, p. 125. Breckenridge Peak (11,000 ft.), Empire Co., Colorado.
Holotype ♀, Aug. 8, 1919.

Eurymus eurytheme tr.f. rudkini.—1932, Can. Ent., LXIV, p. 277. San Marino, Los Angeles Co., California.
Holotype ♀, May 23, 1931.

Eurymus eurytheme amphidusa ab. ♂ **unicitrina.**—1924, Ent. News, XXXV, p. 158, Pl. ii, fig. J. Upland, Los Angeles Co., California.
Holotype ♂, Aug. 2, 1921.

Eurymus philodice tr.f. raritus.—1928, Can. Ent., LX, p. 163, Pl. A, figs. 2 and 2a. Scranton, Pennsylvania (bred by M. Rothke).
Holotype ♀, July 8, 1927.

Eurymus hartfordii ab. ♀ **weaverae.**—1924, Ent. News, XXXV, p. 156, Pl. II, fig. G. Warner Springs, San Diego Co., California.
Allotype ♀, July 3, 1919.

Eurymus harfordii f. ♀ **martini.**—1931, Bull. So. Cal. Ac. Sci., XXX, p. 45, Pl. XV, fig. 4. South side of Arrowhead Lake, San Bernardino Co., California.
Holotype ♀, Sept. 2, 1931.

Eurymus chippewa f. ♀ **kohlsaati.**—1931, Bull. So. Cal. Ac. Sci., XXX, p. 45. Mt. McKinley Nat. Park, Alaska (Frank Morand).
Holotype ♀, July 14, 1930.

Eurymus nastes monia tr.f. **harperi.**—1932, Can. Ent., LXIV, p. 278. Ft. Churchill, Manitoba.
Holotype ♀, July 19, 1932.

Eurema nicippe tr.f. **dammersi.**—1930, Bull. So. Cal. Ac. Sci., XXIX, p. 16, Pl. XIX. San Bernardino, California (bred by Mrs. A. Niece).
Holotype ♀, 1928.

Danaidae

Danaus menippe tr.f. **americanus.**—1927, Ent. News, XXXVIII, p. 137, Pl. XI, fig. 10. Sunny Glen Ranch, Brewster Co., Texas (Poling).
Holotype ♀, July 1926; paratype ♀, Evanston, Ill., 1905; paratype ♀, Provo, Utah, July 26, 1909; paratype ♀, Santa Cruz, California, Oct. 15, 1917.

Danaus menippe tr.f. **nivosus.**—1927, Ent. News, XXXVIII, p. 138. Jefferson Barracks, Mo.
Holotype ♂, Aug. 21, 1908; paratype ♀, Mt. Lebanon, Allegheny Co., Pennsylvania, Oct. 2, 1921.

Satyridae

Oeneis uhleri varuna tr.f. **dennisi.**—1927, Can. Ent., LIX, p. 285, Pl. B, figs, 17, 17b. Beulah, Manitoba (Dennis).
Holotype ♂, May 17, 1904.

Erebia mackinleyensis.—1932, Can. Ent., LXIV, p. 278. Sable Pass, McKinley Nat. Pk., Alaska (Frank Morand).
Holotype ♂, June 16, 1932; allotype ♀, June 21, 1932; paratypes 5 ♂ and 3 ♀ same date and locality.

Nymphalidae

Dione vanillae ab. ♂ **comstocki.**—1925, Ent. News, XXXVI, p. 5, Pl. I, fig. T. Monrovia, Los Angeles Co., California.
Holotype ♂, July 19, 1924.

Dione vanillae insularis tr.f. **fumosus.**—1927, Ent. News, XXXVIII, p. 137, Pl. XI, fig. 9. Los Angeles, Los Angeles Co., California.
Holotype ♀, Sept. 15, 1910.

Dione vanillae incarnata tr.f. **margineapertus.**—1928, Can. Ent., LX, p. 163, Pl. A, fig. 3. Los Angeles, California (Schrader).
Holotype ♂, March 29, 1927; 2 paratypes.

Dione vanillae incarnata tr.f. **hewlettae.**—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 327, Pl. xxxi, fig. 7. Ontario, Riverside Co., California (E. P. Hewlett).

Holotype ♀, summer, 1927.

Euptoieta claudia tr.f. **dodgei*.**—1927, Ent. News, XXXVIII, p. 135, Pl. xi, fig. 6. Near Scribner, Dodge Co., Nebraska.

Holotype ♀, July, 1885, coll. E. A. Dodge.

Argynnis idalia tr.f. **dolli*.**—1927, Can. Ent., LIX, p. 286, Pl. B, figs. 20, 20b. Richmond Hill, Long Island, New York.

Holotype ♀, July 15, 1886, coll. Bklyn. Museum.

Argynnis leto tr.f. **lethe.**—1934, Can. Ent., LXVI, p. 125. Big Horn Mts., Wyoming (E. J. Oslar).

Holotype ♀, Aug. 3, 1932.

Argynnis aphrodite cypris tr.f. **mayae.**—1932, Can. Ent., LXIV, p. 279. Sand Ridge, Bener Dam Lake, near Kelwood, Man. (Mrs. J. F. May).

Holotype ♂, Sept. 10, 1931; allotype ♀, Aug. 17, 1930.

Argynnis aphrodite winni.—1932, Can. Ent., LXIV, p. 278. St. Calixte de Kilkenny, Que. (about 40 m. from Montreal).

Holotype ♂, July 13, 1931; allotype ♀, Strawbridge, Que., Aug. 4, 1930; paratypes, 3 ♂, 3 ♀, similar dates and localities.

Argynnis lais tr.f. **dennisi.**—1927, Can. Ent., LIX, p. 287, Pl. B, fig. 21a. Beulah, Manitoba (Dennis).

Holotype ♂, June 28, 1910.

Argynnis atlantis beani tr.f. **hutchinsi.**—1932, Can. Ent., LXIV, p. 280. Twp. 2N. Range 1W, Jefferson Co., Montana (E. R. Hutchins).

Holotype ♂, July 21, 1929.

Argynnis rhodope tr.f. **gregsoni.**—1932, Can. Ent., LXIV, p. 281. Mt. Washington (6000 ft.), Forbidden Plateau, Vancouver Island, B. C., Canada.

Holotype ♀, July 7, 1931.

Argynnis nevadensis meadii tr.f. **gerhardi*.**—1927, Can. Ent., LIX, p. 287, Pl. B, figs. 24, 24a. Colorado (D. Bruce).

Holotype ♂, no date, coll. Strecker.

Argynnis edwardsii tr.f. **edonis.**—1934, Can. Ent., LXVI, p. 125. Beaver City, Larimer Co., Colorado (10–12,000 ft.) (C. F. Gillette).

Holotype ♀, Aug. 1, 1892.

Argynnis semirannis tr.f. **bernardensis.**—1933, Can. Ent., LXV, p. 172. Camp Wasewgan for Boy Scouts, San Bernardino Mts., San Bernardino Co., California (John S. Garth).

Holotype ♀, July 14, 1932.

Argynnis calippe var. **comstocki.**– 1925, Ent. News, XXXVI, p. 8, Pl. i, figs. 6 ♂, 7 ♀. Los Angeles, Los Angeles Co., California.

Holotype ♂, May 26, 1919; allotype ♀, same locality, May 20, 1920; paratypes, 11 ♂, 5 ♀, same locality and dates.

Argynnis comstocki tr.f. **creelmani.**—1934, Can. Ent., LXVI, p. 127. East San Diego, California.

Holotype ♂, June 13, 1933.

Argynnis montivaga malcolmi tr.f. **sineargentatus.**—1927, Can. Ent., LIX, p. 286, Pl. B, fig. 19. Mammoth, Mono Co., California.

Holotype ♂, Aug. 7, 1922.

Argynnis montivaga ab. ♂ **mammothi.**†—1924, Ent. News, XXXV, p. 157, Pl. II, fig. H. Mammoth Camp, Mono Co., California.

Holotype ♂, July 31, 1921; paratype ♂, same locality, July 28, 1921.

Argynnis mormonia tr.f. **benjamini***.—1927, Can. Ent., LIX, p. 287, Pl. B, figs. 22, 22a. Arangie, Idaho.

Holotype ♂, no date, coll. Barnes.

Argynnis eurynome tr.f. **brucei***.—1927, Can. Ent., LIX, p. 287, Pl. B, figs. 23, 23a. Colorado (D. Bruce).

Holotype ♀, 1890, coll. Strecker.

Argynnis eurynome washingtonia f. **ranierensis.**—1932, Can. Ent., LXIV, p. 282. Paradise Valley, Mt. Ranier, Pierce Co., Washington.

Holotype ♂, Aug. 12, 1931; allotype ♀, Aug. 10, 1931; paratypes, 3 ♂, 3 ♀, Aug. 8–12, 1931, same locality.

Argynnis eurynome artonis f. **rubyensis.**—1932, Can. Ent., LXIV, p. 282. Franklin Slough, near Wright's Ranch, Ruby Valley, Elko Co., Nevada.

Holotype ♂, July 9, 1929; allotype ♀, July 12, 1929; paratypes, 6 ♂, same dates and locality.

Argynnis dodgei.—1931, Bull. So. Cal. Ac. Sci., XXX, p. 46. Diamond Lake, Douglas Co., Oregon.

Holotype ♂, July 10, 1930; allotype ♀, July 17, 1931; paratypes, 10 ♂, 3 ♀, same place and dates.

Argynnis hennei.—1934, Can. Ent., LXVI, p. 126. Mt. Pinos (7700 ft.), Frazier Mt. Park, Santa Barbara Nat. Forest, Ventura Co., California.

Holotype ♂, allotype ♀, July 10, 1933; and paratypes, 6 ♂, 3 ♀.

Argynnis pfoutsi.—1933, Can. Ent., LXV, p. 171. Mt. Loafer, near Payson, Utah.

Holotype ♂, July 16, 1932; allotype ♀, July 16, 1932, Payson Canyon, near Payson, Utah; paratypes, 2 ♂, 2 ♀, same date and localities.

Argynnis garretti.—1932, Can. Ent., LXIV, p. 282. Cranbrook, B. C.

Holotype ♂, July 29, 1929; allotype ♀, July 27, 1929; paratypes, 2 ♂, 2 ♀.

Argynnis albrighti.—1932, Can. Ent., LXIV, p. 281. Highwood Mts., Chouteau Co., Montana.

Holotype ♂, allotype ♀, both June 24, 1931; paratype ♂, Monarch, Cascade Co., July 26, 1931.

Argynnis macdunnoughi*.—1932, Can. Ent., LXIV, p. 280. Elkhorn Ranch Resort, Gallatin Co., Montana.

Holotype ♂; allotype ♀, both Aug. 1, 1928, Can. Nat. coll.; paratypes, 4 ♂, 1 ♀, pair in Amer. Mus. Nat. History.

Argynnis whitehousei.—1932, Can. Ent., LXIV, p. 279. Jaffray, B. C.

Holotype ♂, allotype ♀, both Aug. 5, 1929; paratypes 2 ♂, 2 ♀, same date and locality.

Argynnis montivaga tr.f. **boharti.**—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 326, Pl. XXXI, fig. 5. Mono Pass Trail (Yosemite to Mono Lake), California (R. M. Bohart).

Holotype ♀, July 16, 1929.

Brenthis myrina ab. ♂ **serratimarginata.**—1926, Ent. News, XXXVII, p. 7, Pl. I, fig. 10. Vernon, B. C.

Holotype ♂, Aug. 12, 1904.

Brenthis myrina tr.f. nivea.—1928, Can. Ent., LX, p. 163, Pl. A, fig. 4. Staten Island, New York (O. Fulda).
Holotype ♂, May 28, 1900.

Brenthis aphirape dawsoni tr.f. harperi.—1934, Can. Ent., LXVI, p. 127. Churchill, Manitoba.
Holotype ♂, July 11, 1933.

Brenthis helena ingens tr.f. martini.—1934, Can. Ent., LXVI, p. 127. Teton Trail, Teton Mts., Teton Co., Wyoming.
Holotype ♂, July 8, 1931.

Brenthis chariclea oenone tr.f. labradorensis*.—1928, Can. Ent., LX, p. 163, Pl. A, figs. 5, 5a. Labrador.
Holotype ♂, no date, coll. Barnes.

Brenthis epithore ab. ♂ wawonae.—1924, Ent. News, XXXV, p. 156, Pl. II, fig. F. Wawona, Mariposa Co., California.
Holotype ♂, July 6, 1922.

Brenthis epithore ab. ♀ obscuripennis.—1926, Ent. News, XXXVII, p. 7, Pl. I, fig. 9. Chilcolin, B. C.
Holotype ♀, May 30, 1915.

Brenthis alberta tr.f. banffensis.—1932, Pan. Pac. Ent., VIII, p. 125. Banff, Alberta (J. F. May).
Holotype ♂, July 21, 1930.

Euphydryas chalcedona ab. ♀ omniluteofuscus.—1925, Ent. News, XXXVI, p. 195, Pl. V, fig. 4. Santa Monica, Los Angeles Co., California.
Holotype ♀, May 30, 1924.

Euphydryas chalcedona ab. ♂ hemiluteofuscus.—1925, Ent. News, XXXVI, p. 196, Pl. V, fig. 5. Altruas, Modoc Co., California.
Holotype ♂, May 30, 1924.

Euphydryas colon, tr.f. mcdunnoughi*.—1928, Can. Ent., LX, p. 163, Pl. A, figs. 6, 6a. Corvallis, Oregon (Buckell).
Holotype ♂, June 20, 1925, Can. Nat. coll.

Euphydryas chalcedona colon tr.f. fenderi.†—1932, Pan. Pac. Ent., VIII, p. 125, near McMinnville, Yamhill Co., Oregon.
Holotype ♂, May 29, 1931.

Euphydryas wallacensis.—1928, Pan. Pac. Ent., V, p. 50, Pl. II, fig. C. Wallace, Idaho.
Holotype ♂; allotype ♀, May 29, 1921; paratypes, 20 pairs.

Euphydryas chalcedona wallacensis tr.f. idahoensis.—1929, Pan. Pac. Ent., VI, p. 3. Wallace, Idaho (Huelleman).
Holotype ♀, June 4, 1921.

Euphydryas perdicias ab. ♂ nigrisupernipennis.—1926, Ent. News, XXXVII, p. 4, Pl. I, fig. 5. Chilcotin, B. C.
Holotype ♂, July 17, 1915.

Euphydryas chalcedona perdiceas svihlae.—1932, Pan. Pac. Ent., VIII, p. 126. Hurricane Hill, Olympic Mts., Washington.
Holotype ♀, July 6, 1931.

Euphydryas chalcedona mcglashanii f. truckeensis.—1928, Ent. News, XXXIX, p. 305, Pl. XIV, figs. B ♂ and BB ♀. Truckee, California (Dodge and Cottle).

Holotype ♂, July 18, 1925; allotype ♀, June 28, 1928; paratypes, 3 ♀, July 18, 1926 (1) and July 18, 1916 (2).

Euphydryas chalcedona mcglashanii tr.f. hilli.—1928, Ent. News, XXXIX, p. 306, Pl. XIV, fig. C. Auburn, near Truckee, California (Chas. Hill).

Holotype ♀, July 12, 1928.

Euphydryas sierra ab. ♂ magdelenae.—1925, Ent. News, XXXVI, p. 197, Pl. V, fig. 8. Glen Alpine Creek, El Dorado Co., California.

Holotype ♂, May 10, 1921.

Euphydryas chalcedona olancha f. georgei.—1928, Ent. News, XXXIX, p. 306, Pl. XIV, figs. D ♂ and DD ♀. Casa Diablo Hills, Mono Co., California (Malcolm).

Holotype ♂, allotype ♀, June 23, 1925; paratypes, 2 ♂, 2 ♀, same date and locality.

Euphydryas chalcedona olancha tr.f. malcolmi.—1927, Ent. News, XXXVIII, p. 134, Pl. XI, fig. 3. Casa Diablo, Mono Co., California.

Holotype ♀, June 22, 1925.

Euphydryas chalcedona quino tr.f. hennei.—1932, Pan. Pac. Ent., VIII, p. 126. Chino Canyon, Palm Springs, California.

Holotype ♀, April 14, 1930.

Euphydryas anicia tr.f. mayi.—1932, Pan. Pac. Ent., VIII, p. 126. Banff, Alberta (J. F. May).

Holotype ♂, July 4, 1930.

Euphydryas anicia capella ab. ♂ oslari.—1925, Ent. News, XXXVI, p. 196, Pl. V, fig. 7. Platte Canyon, Colorado.

Holotype ♂, July, 1924.

Euphydryas bernadetta tr.f. leussleri*.—1927, Ent. News, XXXVIII, p. 136, Pl. XI, fig. 8. Near Harrison, Sioux Co., Nebraska.

Holotype ♂, June 5, 1919, coll. R. A. Leussler.

Euphydryas anicia bernadetta tr.f. belli.—1929, Pan. Pac. Ent., VI, p. 4. Harrison, Sioux Co., Nebraska (E. L. Bell).

Holotype ♂, June 16, 1929.

Euphydryas maria tr.f. skinneri*.—1928, Can. Ent., LX, p. 164, Pl. A, figs. 9, 9a. Eureka, Utah (Spalding).

Holotype ♂, May 27, 1920, coll. Barnes.

Euphydryas maria tr.f. spaldingi*.—1928, Can. Ent., LX, p. 165, Pl. A, figs. 10, 10a. Stockton, Utah (Spalding).

Holotype ♀, May 23, 1924, coll. Barnes.

Euphydryas carmentis tr.f. charlotteae*.—1928, Can. Ent., LX, p. 165, Pl. B, figs. 11, 11a. Pagosa Springs, Archuleta Co., Colorado.

Holotype ♀, June 24–30, coll. Barnes?

Euphydryas anicia wheeleri tr.f. duncani.—1934, Can. Ent., LXVI, p. 129. Santa Catalina Mts., Arizona (D. H. Duncan).

Holotype ♂, April 12, 1933.

Euphydryas morandi.—1928, Ent. News, XXXIX, p. 304, Pl. XIV, figs. A ♂ and AA ♀. Kyle Canyon, 10,500–11,000 ft., Mt. Charleston Peak in Spring Mt., Clark Co., Nevada.

Holotype ♂, allotype ♀, July 12, 1928; paratypes, 18 ♂, 9 ♀, July 10 to 16, same locality.

Euphydryas anicia hernosa tr.f. venusta.—1932, Pan. Pac. Ent., VIII, p. 127. Cottonwood Canyon, above Roosevelt Camp, Roosevelt Dam, Arizona (F. Morand).

Holotype ♀, July 29, 1930.

Euphydryas irelandi.—1929, Can. Ent., LXI, p. 44. Trail near Alta Peak, Sequoia Nat. Park, California.

Holotype ♂, August 6, 1927; allotype ♀, July 17, 1928 (Ireland); paratypes, 1 ♂, 3 ♀, same dates and locality.

Euphydryas anicia windi.—1932, Can. Ent., LXIV, p. 283. Timber Island, Teton Mts., Teton Co., Wyoming.

Holotype ♂, allotype ♀, both June 29, 1931; paratypes, 4 ♂, same date and locality.

Euphydryas anicia hopfingeri.—1934, Can. Ent., LXVI, p. 128. Black Canyon, Methow Valley, Okanogan Co., Washington.

Holotype ♂, allotype ♀, May 28, 1933.

Euphydryas anicia hopfingeri tr.f. andersoni.—1934, Can. Ent., LXVI, p. 128. Black Canyon, Methow Valley, near Brewster, Okanogan Co., Washington.

Holotype ♀, May 28, 1933.

Euphydryas editha ab. ♂ fieldi.—1924, Ent. News, XXXV, p. 155, Pl. II, fig. E. San Diego, San Diego Co., California.

Holotype ♂, April 26, 1920.

Euphydryas rubicunda tr.f. cottlei.—1928, Can. Ent., LX, p. 164, Pl. A, figs. 7, 7a. Lower Yosemite Valley, California (Cottle).

Holotype ♂, June, 1909.

Euphydryas editha wrighti.—1929, Pan. Pac. Ent., VI, p. 5. San Diego, California (George Field).

Holotype ♂, allotype ♀, March 7 and 8, 1907; 12 pairs paratypes, same date and locality.

Euphydryas editha wrighti tr.f. thornei.—1934, Can. Ent., LXVI, p. 129. Chula Vista, San Diego, California.

Holotype ♀, March 9, 1930.

Euphydryas monoensis.—1928, Pan. Pac. Ent., V, p. 49, Pl. II, fig. A. Rush Creek (below Farmington's Ranch) near Mono Lake, Mono Co., Calif.

Holotype ♂, allotype ♀, June 14, 1926; paratypes, 10 pairs from same locality and 1 pair, Levinning Creek, near type locality, July 13, 1927.

Euphydryas editha nubigena tr.f. tiogaensis*.— 1929, Pan. Pac. Ent., VI, p. 6. Tioga Pass, Yosemite Nat. Park, Calif. (Comstock).

Holotype ♂, August 3, 1922, coll. Los Angeles Mus.

Euphydryas editha nubigena tr.f. boharti.—1929, Pan. Pac. Ent., VI, p. 6. Tuolumne Meadows, Yosemite Nat. Pk., California.

Holotype ♀, July 5, 1928.

Euphydryas aurilacus.—1928, Pan. Pac. Ent., V, p. 49, Pl. II, fig. B. Near Gold Lake Camp, Gold Lake, Sierra Co., California.

Holotype ♂, allotype ♀, July 15, 1925; paratypes, 6 pairs and Fig. 11 ♂ and 12 ♀, Pl. XXXIV, 'Butts. of Calif.' also designated paratypes.

Euphydryas rubicunda ab. ♂ albiradiata.—1926, Ent. News, XXXVII, p. 3, Pl. I, fig. 4. Loyalton, Sierra Co., California.

Holotype ♂, July 19, 1922.

Euphydryas rubicunda ab. foxi.—1924, Ent. News, XXXV, p. 155, Pl. II, fig. D. Gold Lake, Sierra Co., California.
Holotype ♂, July 17, 1921; paratype ♂, same locality, July 13, 1921.

Euphydryas editha baroni tr.f. dunni.—1929, Pan. Pac. Ent., VI, p. 6. Mendoceno Co., California (Eastman).
Holotype ♂, 1912.

Euphydryas editha baroni tr.f. sternitzkyi.—1929, Pan. Pac. Ent., VI, p. 6 (Sternitzky). Hillsboro, near San Mateo, San Mateo Co., California.
Holotype ♀, April 27, 1929.

Euphydryas taylori, ab. ♀ victoriae.—1926, Ent. News, XXXVII, p. 4, Pl. I, fig. 6. Victoria, B. C.
Holotype ♀, April 4, 1921.

Euphydryas taylori tr.f. barnesi*.—1928, Can. Ent., LX, p. 164, Pl. A, figs. 8, 8a. Victoria, B. C. (Crocker).
Holotype ♂, May 9, 1910; allotype ♀, May 4, 1910; paratype ♂, May 9, 1910, coll. Barnes.

Euphydryas nubigena beani ab. ♂ blackmorei.—1926, Ent. News, XXXVII, p. 2, Pl. I, fig. 1. Mt. Cheam, B. C.
Holotype ♂, August 3, 1903.

Euphydryas editha lehmani.—1929, Pan. Pac. Ent., VI, p. 7. Lehman Caves Resort, Mt. Wheeler, White Pine Co., Nevada.
Holotype ♂, allotype ♀, June 4, 1929; paratypes, 10 pairs, same locality, early June dates.

Euphydryas editha lehmani tr.f. caverna.—1934, Can. Ent., LXVI, p. 129. Mt. Wheeler, White Pine Co., Nevada (Frank Morand).
Holotype ♀, June 8, 1929.

Euphydryas editha lawrencei.—1931, Bull. So. Cal. Ac. Sci., XXX, p. 47. Near timber line on trail between Diamond Lake (Camp) and summit of Mt. Thielsen (9000 ft.), Douglas Co., Oregon.
Holotype ♂, allotype ♀, July 17–18, 1931; paratypes, 10 ♂, 10 ♀, same place and date.

Euphydryas editha laurencei tr.f. thielsenensis.—1931, Bull. So. Cal. Ac. Sci., XXX, p. 48. Timber line, on Mt. Thielsen, Douglas Co., Oregon (Fred Lawrence).
Holotype ♀, July 17, 1931; paratype ♀, same date and locality.

Euphydryas editha laurencei tr.f. diamondensis.—1931, Bull. So. Cal. Ac. Sci., XXX, p. 48. Timber line, Mt. Thielsen, Douglas Co., Oregon (Fred Lawrence).
Holotype ♂, July 17, 1930; paratype ♂, same date and locality.

Euphydryas editha fridayi.—1931, Bull. So. Cal. Ac. Sci., XXX, p. 47. Near auto road on left between June and Silver Lakes, Mono Co., California.
Holotype ♂, allotype ♀, June 14, 1930; paratypes, 3 ♂, 3 ♀, same date and locality.

Euphydryas gilletti tr.f. herri.—1929, Pan. Pac. Ent., VI, p. 8. Martina near Stark, Missoula Co., Montana.
Holotype ♀, July 9, 1929.

Melitaea sterope tr.f. hopfingeri.—1934, Can. Ent., LXVI, p. 129. Aster Island (Columbia River) near Brewster, Okanogan Co., Washington.
Holotype ♂, May 14, 1933.

Melitaea neumoegeni tr.f. fridayi.—1932, Can. Ent., LXIV, p. 283. Little Rock, Los Angeles Co., California.
Holotype ♀, April 3, 1932.

Melitaea neumoegeni tr.f. boharti.—1933, Can. Ent., LXV, p. 173. Little Rock, Los Angeles Co., California (R. M. Bohart).
Holotype ♂, April 2, 1932.

Euphydryas gabbi ab. ♂ pasadenae.—1924, Ent. News, XXXV, p. 155, Pl. II, fig. C. Pasadena, Los Angeles Co., California.
Holotype ♂, May 20, 1921.

Melitaea acastus ab. ♀ pearlae.—1926, Ent. News, XXXVII, p. 5, Pl. I, fig. 7. Casa Diablo Hills, Mono Co., California.
Holotype ♀, June 23, 1925; paratype ♀, same locality, June 24, 1925.

Melitaea palla ab. ♀ blackmorei.—1926, Ent. News, XXXVII, p. 6, Pl. I, fig. 8. Lytton, B. C.
Holotype ♀, July 4, 1922.

Melitaea palla whitneyi tr.f. vanduzeei*.—1928, Can. Ent., LX, p. 165, Pl. B, figs. 12a, 12. Portola, California (Newcomer).
Holotype ♂, April 25, 1908, coll. Acad. Nat. Sci.

Melitaea hoffmanni tr.f. hollandae*.—1928, Can. Ent., LX, p. 166, Pl. B, figs. 13, 13a. Summit, California.
Holotype ♀, July 24, coll. Holland.

Melitaea chara ab. ♂ jacintoi.—1924, Ent. News, XXXV, p. 154, Pl. II, fig. B. Palm Springs, Riverside Co., California.
Holotype ♂, May 28, 1922.

Melitaea wrighti ab. ♂ carolynae.—1926, Ent. News, XXXVII, p. 3, Pl. I, fig. 3. Mint Canyon, Los Angeles Co., California.
Holotype ♂, May 5, 1925.

Melitaea wrightii f. pelona*.—1930, Bull. So. Cal. Ac. Sci., XXIX, p. 25. Mint Canyon, Sierra Poloner Valley, California (J. A. Comstock).
Holotype ♀, May 1, 1921, coll. J. A. Comstock.

Melitaea cyneas tr.f. infrequens*.—1928, Can. Ent., LX, p. 166, Pl. B., figs., 14, 14a. Huachuca Mts., Arizona.
Holotype ♂, August 8–15, coll. Barnes.

Lemonias alma tr.f. koebelei*.—1927, Ent. News, XXXVIII, p. 136, Pl. XI, fig. 7. Argus Mts., Inyo Co., California.
Holotype ♀, April, 1891, coll. Koebele, Acad. Nat. Sci.

Melitaea theona thekla tr.f. benjamini*.—1928, Can. Ent., LX, p. 166, Pl. B, figs. 15, 51a. Southern Arizona (Poling).
Holotype ♂, July 15–30, coll. Barnes.

Melitaea pola arachne ab. ♂ polingi.—1926, Ent. News, XXXVII, p. 2, Pl. I, fig. 2. White Mts., Arizona.
Holotype ♂, Aug., 1925.

Melitaea mayi.—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 327, Pl. XXXI, fig. 6. Small high valley 4 miles west of Ptargmigan Valley, Banff, Alberta (J. F. May).
Holotype ♂, July 28, 1929.

Phyciodes gorgone tr.f. **thornei**.—1934, Can. Ent., LXVI, p. 130. Chula Vista, San Diego Co., California (Fred Thorne).
Holotype ♂, Oct. 11, 1933.

Phyciodes gorgone tr.f. **nox***.—1928, Can. Ent., LX, p. 167, Pl. B, figs. 17, 17a. Brownsville, Texas (Dorner).
Holotype ♂, April, 1911; allotype ♀, Kerrville, Tex., coll. Barnes.

Phyciodes nycteis tr.f. **lacteus**.—1928, Can. Ent., LX, p. 166, Pl. B, figs. 16, 16a. Near St. Louis, Mo. (Knetzge).
Holotype ♂, July 10, 1908.

Phyciodes tharos tr.f. **dyari***.—1928, Can. Ent., LX, p. 167, Pl. B, fig. 18. Webster, New Hampshire.
Holotype ♂, U. S. Nat. Mus.

Phyciodes batesii, tr.f. **harperi**.—1932, Can. Ent., LXIV, p. 283. McCreary, Manitoba.
Holotype ♀, Aug. 1, 1931.

Phyciodes campestris tr.f. **mcdunnoughi***.—1928, Can. Ent., LX, p. 167, Pl. B, fig. 19, 19a. Olds? (T. N. W.).
Holotype ♀, no date, Can. Nat. coll.

Phyciodes orseis tr.f. **edwardsi***.—1927, Ent. News, XXXVIII, p. 135, Pl. XI, fig. 5. California.
Holotype ♀, coll. Barnes.

Phyciodes mylitta tr.f. **collinsi**.—1930, Bull. So. Cal. Ac. Sci., XXIX, p. 26. Collin's Ranch, Voltair, California.
Holotype ♂, Aug. 12, 1923.

Chlosyne lacinia rufescens tr.f. **inghami**.—1928, Can. Ent., LX, p. 167, Pl. B, figs. 20, 20a. Mesa, Arizona (Ingham).
Holotype ♂, Aug. 23, 1927.

Chlosyne california ab. ♀ **chinoi**.—1924, Ent. News, XXXV, p. 157, Pl. II, fig. 1. Palm Springs (Chino Canyon), Riverside Co., California.
Allotype ♀, Oct. 18, 1921.

Polygonia satyrus marsyas tr.f. **hollandi***.—1927, Bull. So. Cal. Ac. Sci., XXVI, p. 53. Navarro, California (bred by O. T. Barron).
Holotype ♂, coll. W. H. Edwards.

Aglais milberti tr.f. **rothkei**.—1927, Can. Ent., LIX, p. 286, Pl. B, figs. 18, 18b. Scranton, Pennsylvania (Rothke).
Holotype ♂, July 21, 1915.

Vanessa virginiensis ab. ♂ **massachusettensis**.—1925, Ent. News, XXXVI, p. 198, Pl. V, fig. 10. Southhampton, Massachusetts.
Holotype ♂, July 20, 1923.

Cynthia virginiensis tr.f. **simmsi***.—1927, Ent. News, XXXVIII, p. 133, Pl. XI, fig. 2. Montreal, Quebec.
Holotype ♀, Sept. 12, 1913, coll. H. M. and F. H. Simms, Stourbridge, Wor., England; paratype ♀, Raleigh, N. C., coll. Amer. Mus. Nat. History.

Cynthia carye, tr.f. **schraderi**.—1929, Pan. Pac. Ent., VI, p. 9, Pl. XVII. Los Angeles, California.
Holotype ♂, May 13, 1929; allotype ♀, May 6, 1929; 2 paratypes, ♀, May 28, 1929, and date unknown.

Cynthia carye tr.f. **nivosa**.—1927, Bull. So. Cal. Ac. Sci., XXVI, p. 53. San Francisco, California (Cottle).
Holotype ♂, Aug., 1915.

Junonia coenia ab. ♀ **schraderi**.—1925, Ent News, XXXVI, p. 199, Pl. v, fig. 11. Los Angeles, California.
Holotype ♀, May 17, 1910.

Junonia coenia tr.f. **wilhelmi**.—1927, Ent. News, XXXVIII, p. 134, Pl. xi, fig. 4. Los Angeles, California (Schrader).
Holotype ♂, Sept. 15, 1910; paratype ♀, Oct. 15, 1913.

Basilarchia astyanax f. **purpuratus**.—1934, Can. Ent., LXVI, p. 43. Scranton, Pennsylvania (Max Rothke).
Holotype ♂, July 4, 1914; allotype ♀, July, 1926.

Basilarchia astyanax arizonensis tr.f. **doudoroffi**.—1934, Can. Ent., LXVI, p. 44. Tonto Creek, near Payson, Gila Co., Arizona (M. Doudoroff).
Holotype ♂, July 12, 1933.

Basilarchia lorquini f. **fridayi**.—1932, Can. Ent., LXIV, p. 284. Leevining Creek, near Mono Lake, Mono Co., California.
Holotype ♀, July 22, 1930.

Basilarchia lorquini ab. ♂ **comstocki**.—1925, Ent. News, XXXVI, p. 5, Pl. i, fig. S. Bishop, Inyo Co., California.
Holotype ♂, Aug. 28, 1921.

Basilarchia archippus tr.f. **nivosus**.—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 325, Pl. xxx, fig. 1. Mystic, Connecticut.
Holotype ♂, July.

Basilarchia archippus hyb. **rubrofasechippus**.—1934, Can. Ent., LXVI, p. 47. Beulah, Manitoba (A. J. Dennis).
Holotype ♂, June 29, 1904.

Lycaenidae

Atlides halesus tr.f. **corcorani**.—1934, Can. Ent., LXVI, p. 131. Riverside, Riverside Co., California.
Holotype ♂, Sept. 2, 1933.

Strymon melinus tr.f. **meinersi**.—1927, Can. Ent., LIX, p. 283, Pl. A, figs. 9, 9a. Table Rock, North Carolina (Meiners).
Holotype ♀, Aug. 18, 1922.

Callipsyche behrii ab. ♂ **nigroinita**.—1924, Ent. News, XXXV, p. 154, Pl. xi, fig. A. Mammoth Camp, Mono Co., California.
Holotype ♂, Aug. 5, 1921.

Satyrium fuliginosa tr.f. **immaculata**.—1927, Can. Ent., LIX, p. 283. McGee's Creek, near Mammoth, Mono Co., California.
Holotype ♀, June 20, 1926.

Lycaena dione tr.f. **gibboni***.—1927, Can. Ent., LIX, p. 284, Pl. A, fig. 13. Miniota, Manitoba (Gibbon).
Holotype ♂, July 4, Can. Nat. coll.

Lycaena editha tr.f. **vanduzeei***.—1927, Ent. News, XXXVIII, p. 133, Pl. xi, fig. 1. Deer Park, Placer Co., California.
Holotype ♀, coll. Calif. Acad. Sci.

Lycaena thoe tr.f. **wormsbacheri***.—1927, Bull. So. Cal. Ac. Sci., XXVI, p. 53. No type locality given.

Holotype ♀, coll. H. Wormsbacher.

Lycaena thoe tr.f. **wyatti***.—1927, Can. Ent., LIX, p. 285, Pl. A, figs. 16, 16b. Colorado?

Holotype ♂, no date, coll. Strecker; allotype ♀, Sept. 15, 1907, Chicago, Illinois; paratypes ♂, June 9, 1918, Omaha, Nebraska, ♀, June 20, 1918, Chicago.

Lycaena thoe tr.f. **sternitzkyi.**—1927, Can. Ent., LIX, p. 285, Pl. A, fig. Petaluma, California (Sternitzky).

Holotype ♂, Aug. 1, 1927.

Lycaena helloides tr.f. **williamsi***.—1927, Can. Ent., LIX, p. 285, Pl. A, figs. 14, 14a, 14b. Hall's Valley, Park Co., Colorado.

Holotype ♂, Aug.; allotype ♀, May 30, 1897, Chicago, Illinois, coll. Acad. Nat. Sc. Phila.

Heodes cupreus ab. ♀ **maculinita.**—1926, Ent. News, XXXVII, p. 8, Pl. I, fig. 11. Mammoth, Mono Co., California.

Holotype ♀, July 12, 1920; paratype ♀, same locality and date.

Lycaena snowi tr.f. **mcdunnoughi***.—1927, Can. Ent., LIX, p. 284, Pl. A, fig. 12. Laggan, Alta (F. H. W. Dodd).

Holotype ♀, July 20, 1904; paratypes, 2 ♀, July 20, 1904. (Dodd and T. E. Bean), all in Can. Nat. coll.

Heodes heteronia ab. ♂ **coloradensis.**—1925, Ent. News, XXXVI, p. 194, Pl. V, fig. 1. Plain View, Colorado.

Holotype ♂, July, 1924.

Leptotes marina ab. ♀ **violacea.**—1925, Ent. News, XXXVI, p. 6, Pl. I, fig. U. Oak Glenn, Riverside Co., California.

Allotype ♀, July 19, 1924.

Brephidium exilis ab. ♀ **coolidgei.**—1925, Ent. News, XXXVI, p. 2, Pl. I, fig. L. Los Angeles, Los Angeles Co., California.

Allotype ♀, July 12, 1922; paratype ♀, same locality, Aug. 3, 1922.

Everes comyntas herii tr.f. **arizonensis***.—1927, Can. Ent., LIX, p. 284, Pl. A, fig. 10. Santa Rita Mts., Arizona (Clemence).

Holotype ♂, April 18, 1910, coll. Los Angeles Mus.

Everes comyntas herrii tr.f. **jemezensis***.—1927, Can. Ent., LIX, p. 284, Pl. A, fig. 11. Jemez Springs, New Mexico.

Holotype ♀, May 13, 1913, coll. Acad. Nat. Sci. Phila.

Everes amyntula tr.f. **dodgei.**—1927, Can. Ent., LIX, p. 283, Pl. A, fig. 7. Santa Cruz, California (E. A. Dodge).

Holotype ♂, April 20, 1918

Plebeius melissa tr.f. **inyoensis.**—1927, Can. Ent., LIX, p. 281, Pl. A, fig. 1. Olancha, Inyo Co., California (G. A. Malcolm).

Holotype ♂, July 2, 1925.

Plebeius aquilo tr.f. **kohlsaati.**—1932, Pan. Pac. Ent., VIII, p. 127. Mt. McKinley Nat. Pk., Alaska (F. Morand).

Holotype ♂, July 29, 1930

Plebeius saepiolus tr.f. **boharti.**—1932, Pan. Pac. Ent., VIII, p. 127. Yosemite Nat. Park., California (R. M. Bohart).
Holotype ♀, July 24, 1931.

Plebeius saepiolus tr.f. **leussleri*.**—1927, Can. Ent., LIX, p. 282, Pl. A, fig. 3. Cassel's, Park Co., Nebraska, alt. 8500 ft.[1]
Holotype ♀, Aug. 23, 1918, coll. Leussler.

Plebeius saepiolus hilda tr.f. **garthi.**—1928, Can. Ent., LX, p. 168, Pl. B, fig. 21. Tahquitz Valley, Riverside Co., California (Garth).
Holotype ♀, June 27, 1927.

Plebeius icarioides ab. ♂ **spinimaculata.**—1926, Ent. News, XXXVII, p. 8, Pl. I, fig. 12. Delta, Trinity Co., California.
Holotype ♂, May 22, 1925.

Plebeius maricopa tr.f. **windi.**—1933, Can. Ent., LXV, p. 173. Berkeley, California (Robert Wind).
Holotype ♂, April 14, 1932.

Plebeius acmon tr.f. **angelus.**†—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 326, Pl. XXXI, fig. 4. Los Angeles, California.
Holotype ♀, June 10, 1920.

Plebeius monticola ab. ♀ **malcolmi.**—1925, Ent. News, XXXVI, p. 195, Pl. V, fig. 2. Ridge Route, Los Angeles Co., California.
Holotype ♀, May 30, 1922.

Plebeius monticola ab. ♀ **pallida.**—1925, Ent. News, XXXVI, p. 3, Pl. I, fig. N. Cajon Pass, San Bernardino Mts., San Bernardino Co., California.
Allotype ♀, May 14, 1922.

Plebeius monticola tr.f. **montanus.**—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 326, Pl. XXXI, fig. 3. Cajon Pass, San Bernardino Co., California (Karl Coolidge).
Holotype ♂, May 14, 1922.

Philotes battoides bernardino ab. ♀ **baldyensis.**—1925, Ent. News, XXXVI, p. 3, Pl. I, fig. M. Camp Baldy, San Bernardino Co., California.
Allotype ♀, July 5, 1924.

Philotes glaucon intermedia tr.f. **malcolmi.**—1927, Can. Ent., LIX, p. 282, Pl. A, fig. 5. American River, Placer Co., California (Malcolm).
Holotype ♂, July 19, 1921.

Philotes sonorensis f. **comstocki.**—1925, Ent. News, XXXVI, p. 6, Pl. I, fig. 1. San Gabriel River, Duarte, Los Angeles Co., California.
Holotype ♂, March 15, 1922; allotype ♀, same locality, Feb. 20, 1922; paratypes, 6 ♂, 2 ♀, similar dates, 1922–1923.

Phaedrotes piassus catalina ab. ♂ **gorgonioi.**—1925, Ent. News, XXXVI, p. 4, Pl. I, fig. P. San Gorgonio Mt., San Bernardino Co., California.
Holotype ♂, June 13, 1921.

Glaucopsyche lygdamus couperi tr.f. **mcdunnoughi*.**—1927, Can. Ent., LIX, p. 282, Pl. A, figs. 4, 4a, 4c, 4d. Saskatchewan.
Holotype ♂, no date, coll. Barnes; allotype ♀, June 26, 1894, in Can. Nat. coll.

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[1] This type locality as published is incorrect. The true type locality is Cassells, Park Co., Colorado. See: 1938, Can. Ent., LXX, p. 46.

Glaucopsyche lygdamus oro tr.f. leussleri*.—1927, Can. Ent., LIX, p. 283, Pl. A, fig. 8. Harrisburg, Banner Co., Nebraska (Leussler).
Holotype ♂, Aug. 23, 1918, coll. Leussler.

Glaucopsyche lygdamus behri tr.f. sternitzkyi.—1929, Bull. Bklyn. Ent. Soc., XXIV, p. 325, Pl. xxxi, fig. 2. Fairfax, Marin Co., California (R. F. Sternitzky).
Holotype ♂, April 9, 1927; paratype ♂, Trinity Co., California, June 2, 1928.

Glaucopsyche xerxes mertila ab. ♂ huguenini.†—1925, Ent. News, XXXVI, p. 3, Pl. i, fig. O. San Francisco, California.
Holotype ♂, April 24, 1917.

Glaucopsyche xerces f. mertila tr.f. barnesi*.—1927, Can. Ent., LIX, p. 282, Pl. A, figs. 2, 2a. San Francisco, California.
Holotype ♂, April, 1923; allotype ♀, no date, coll. Barnes.

Hesperiidae

Rhabdoides cellus ab. ♂ aereofuscus.—1925, Ent. News, XXXVI, p. 196, Pl. v, fig. 6. Baboquivari Mts., Pina Co., Arizona.
Holotype ♂, July 15, 1924.

Urbanus tessellata occidentalis ab. ♀ skinneri.—1927, Ent. News, XXXVIII, p. 51, fig. 2. Los Angeles, Los Angeles Co., California.
Holotype ♀, July 7, 1926.

Polites sabuleti var. comstocki.—1925, Ent. News, XXXVI, p. 7, Pl. i, figs. 4 ♂, 5 ♀. El Centro, Imperial Co., California.
Holotype ♂, Oct. 4, 1923; allotype ♀, same locality, Oct. 5, 1923; paratypes, 12 ♂, 3 ♀, same locality and dates.

Atrytonopsis edwardsi ab. ♂ polingi.—1925, Ent. News, XXXVI, p. 195, Pl. v, fig. 3. Baboquivari Mts., Pina Co., Arizona.
Holotype ♂, July 22, 1924.

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THE OSTEOLOGY AND RELATIONSHIPS OF THE WAHOO (*ACANTHOCYBIUM SOLANDRI*), A SCOMBROID FISH[1]

By G. Miles Conrad

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INTRODUCTION

During a recent study of the comparative osteology of the swordfish and the sailfish (Gregory and Conrad, 1937), the problem of the evolution of the Xiphiiformes arose. The literature abounds with suggestions that *Acanthocybium* forms a link between the Scombridae and the xiphiiform fishes. Therefore, we were particularly desirous of procuring an *Acanthocybium* for study. Extended correspondence, however, failed to produce the desired specimen.

In July, 1937, the American Museum–Lerner Bimini Expedition went to the Bahama Islands to secure anatomical and body-form data on the blue marlin. While there, Mr. Erl Roman, of Miami, Florida, caught and presented to the expedition a fine specimen of the muchcoveted wahoo (*Acanthocybium solandri*). Detailed measurements of this specimen in the flesh have been published (Conrad and La Monte, 1937). The skeleton has been mounted and has been placed in the study collection of the Department of Ichthyology.

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[1] Results of the Michael Lerner Ichthyological Expeditions, No. 15.

OSTEOLOGY

The snout region of the skull of *Acanthocybium* was figured by Regan (1909), Starks (1910) published valuable notes on the skull and first three vertebrae, Eastman (1914) copied Regan's figure, and Kishinouye (1923) figured the axial skeleton and neurocranium. Kishinouye's figures, while beautifully drawn, are unfortunately so small that many of the details of structure are lost. Nor does he discuss specifically the skeleton of *Acanthocybium*. Thus it seems justifiable to present several new and more detailed drawings of both the skull and the vertebral column. These new drawings are the work of Mrs. Helen Ziska.

The skeleton of *Acanthocybium* (Fig. 1) is particularly notable among the Scombridae for its long skull, which is about one fourth of the standard body length, and its long, many segmented vertebral column.

SKULL

Neurocranium

OLFACTORY REGION.—The dorsal surface of the mesethmoid (Fig. 2, *deth*) of *Acanthocybium* lies slightly below the horizontal plane of the roofing bones of the skull and is slightly overlapped above by the frontals (*fr*). Its condition is essentially like that found in *Scomber*, *Thunnus*, and other Scombridae.

Lateral to the mesethmoid and dorsal to the narial opening is the nasal bone (*na*). In dorsal aspect the nasal of *Acanthocybium* is roughly triangular with the apex directed posteriorly and the base forward. The frontal overlaps the mesial border of the nasal for almost its entire length. The nasal bone of the wahoo is such a dense and stoutly developed element that no trace of the supraorbital canal is evident when the bone is held to the light. *Scomber* has a very different nasal than that of *Acanthocybium*, because in the former the nasals are long and narrow "like a tall and slender S" (Allis, 1903) and project far in front of the mesethmoid. With respect to the nasals, *Acanthocybium* resembles its close relative, *Scomberomorus*, which has similar large triangular-shaped nasal bones.

The parethmoids (Fig. 3, *pareth*) of *Acanthocybium* are well-de-

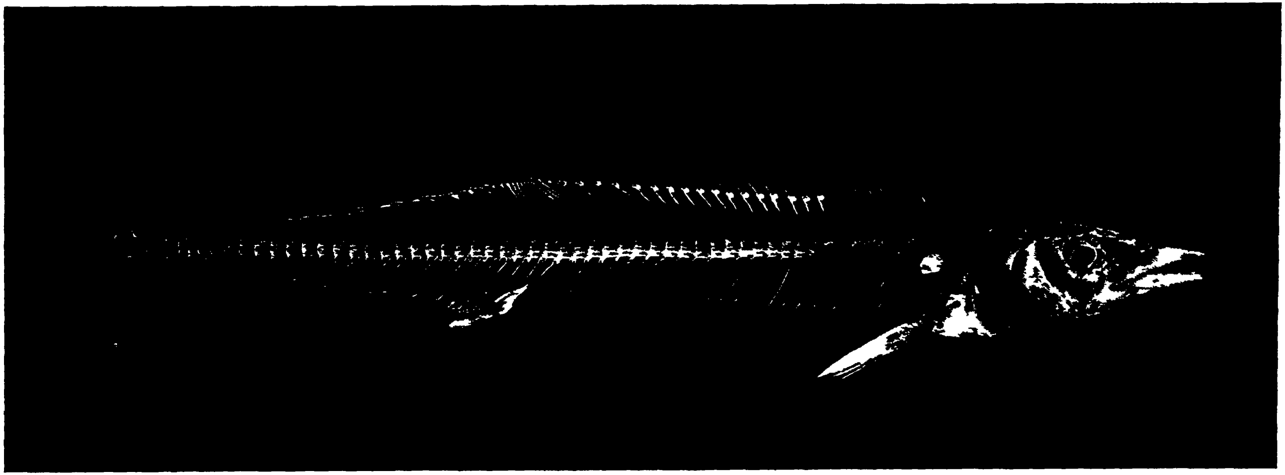

Fig. 1. Skeleton of wahoo (*Acanthocybium solandri*).

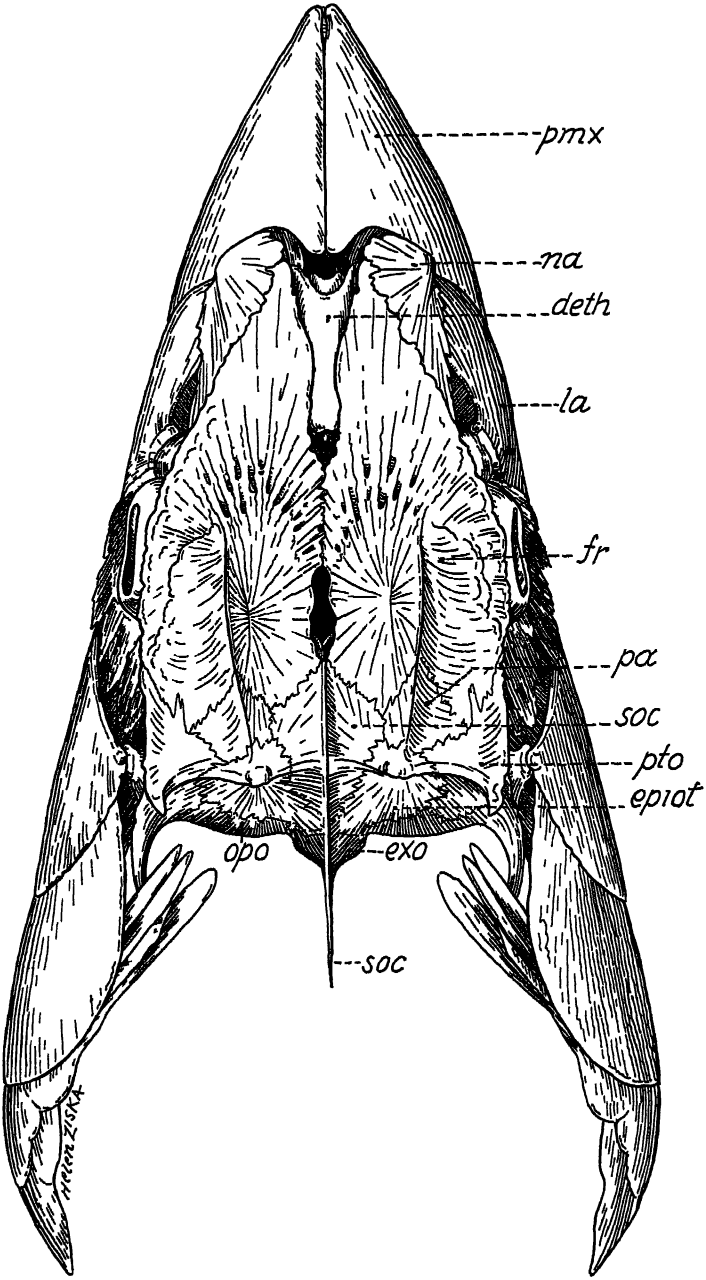

Fig. 2. Skull of *Acanthocybium*. Dorsal view.

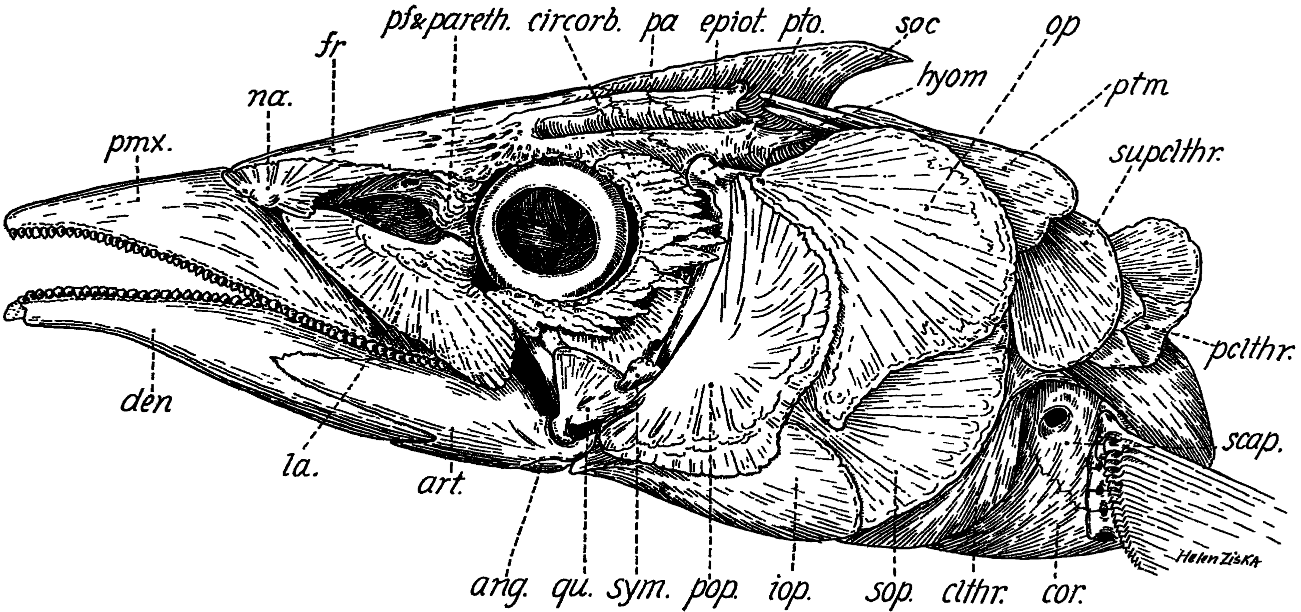

Fig. 3. Skull of *Acanthocybium*. Lateral view.

veloped cellular oil reservoirs which form the anterior margins of the orbits and the posterior and mesial walls of the nasal cavity. On the dorsal surface the parethmoids contact the nasals anteriorly and the frontals posteriorly while medially both contact the mesethmoid. The surface of the parethmoid which lines the nasal cavity is smooth and very unlike the spongy, cellular surface seen in the xiphiiform fishes.

ORBITAL REGION.—In common with most scombroid fishes *Acanthocybium* has a solid, heavy sclerotic case which consists of an anterior half and a posterior half. This sclerotic case, according to Starks (1910), is thicker and more dense than that of any other genus of scombroids.

A constant feature of the Scombridae is the large, much sculptured lacrymal bone (*la*). The large lacrymal of *Acanthocybium* is directed upward and forward, covering completely the maxilla (Fig. 4, *mx*) and supramaxilla (Fig. 4, *smx*). The lacrymal extends forward to lie ventral to the curved anterior end of the palatine (Fig. 5, *pal*) as in *Scomber*. At this same locus the antero-dorsal corner of the lacrymal has a concave, rolled border which fits mesial to the lateral angle of the base of the nasal "triangle." Lateral and dorsal to the palatal process of the parethmoid is the articulation for the lacrymal. Immediately below this articulation with the parethmoid a small hook on the lacrymal overlaps the anterior end of the supramaxilla.

As in *Scomber* and *Scomberomorus* the suborbital bones (*circorb*) posterior to the lacrymal are so mingled with the thick scales surrounding the orbit as to make it impossible to distinguish them. One of the suborbitals, however, is developed into a flange-like bone which projects into the orbit at the postero-inferior part of the ring. The lateral border of the bone bears the circumorbital canal while the mesial flange-like portion follows the contours of the sclerotic case. According to Starks (1910) *Scomberomorus* also possesses such a "suborbital shelf."

The frontals of *Acanthocybium*, with their conspicuous radiating growth lines, form the largest part of the dorsum of the neurocranium. The frontals are pointed anteriorly and diverge to expose the mesethmoid as in *Scomber*. Between the frontals are large fontanelles. One of these fontanelles runs forward about an inch and a half from the fronto-supraoccipital suture. A second starts about three quarters of an inch behind the posterior border of the mesethmoid and extends the remainder of the anterior length of the frontals. The failure of the frontals to close over the entire length of their contact seems to be a typical scombroid aberration (cf. *Scomber*, *Sarda*, *Thunnus*, *Istiophorus*, *Xiphias*, etc.). From the posterior surface of the parethmoid to the sphenotic (*sphot*) the frontal forms the dorsal border of the orbit. Posteriorly the frontals contact on the dorsal surface, the supraoccipital (*soc*), the parietals (*pa*), the pterotics (*pto*), and sphenotics; on the ventral surface, the sphenotics and alisphenoids.

The orbitosphenoid is lacking in *Acanthocybium*, as in *Scomber*.

"In *Scomberomorus*," says Starks (1910), "the brain chamber is open widely between the alisphenoids, while in this genus [*Acanthocybium*] the alisphenoids nearly meet at their middle and almost divide the opening into two parts." Laterally the alisphenoids contact the frontals and sphenotics and posteriorly abut against the proötics.

Otic Region.—In *Acanthocybium* and other Scombridae the opisthotics (*opo*) are not fused with the exoccipitals (*exo*). The condition of the opisthotic, according to Starks (1910), presents a character by which the Scombrinae can be separated from the remainder of the Scombridae. In the Scombrinae (*Scomber*, *Rastrelliger*) the opisthotic is situated on the lower surface of the cranium and is not interposed between the exoccipital and the pterotic. In the other Scombridae, including *Acanthocybium*, the opisthotic may be seen on both the dorsal and ventral surfaces of the cranium and on the lower surface it separates the pterotic from the exoccipital.

The pterotic of *Acanthocybium* ends posteriorly in a sharp spine as in *Scomber* and *Sarda*, but unlike *Scomberomorus* in which the posterior end of the pterotic is truncate.

The epiotic (*epiot*) of *Acanthocybium* is bounded on the dorsal surface of the skull by the parietal, the supraoccipital, the exoccipital and the pterotic. In *Scomber* there is a cartilage (see Allis, 1903, Fig. 5) which lies at the center of a ring of bones composed of epiotic, parietal, and pterotic. In *Acanthocybium*, *Thunnus*, and other scombroid genera, this cartilage is almost completely ossified.

The supraoccipital is in contact with the frontals anteriorly, thus separating the parietals from each other. The condition is therefore like that found in *Scomber* and other Scombridae.

Basicranial Region.—Due to the investing bones present on the mounted skull no observations of the basioccipital or parasphenoid were possible.

The basisphenoid seems to be very similar to the type found in *Scomber*.

Branchiocranium

Oromandibular Region.—The premaxillae (*pmx*) of *Acanthocybium* are large and pointed anteriorly, both the ascending and particularly the

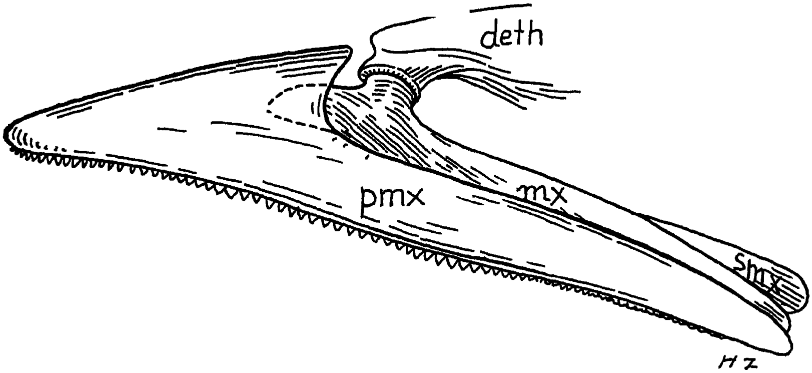

Fig. 4. Diagram showing the relation of the secondary upper jaw to the mesethmoid

descending rami are exceedingly robust. Completely excluded from the gape is the maxilla which reaches from the posterior tip of the premaxilla anteriorly to form a bearing surface upon which the premaxilla rides. The maxilla itself is articulated with the ethmo-vomer block while the premaxilla is held away from the mesethmoid (Fig. 4). This articulation of the secondary upper jaw is essentially the same as that

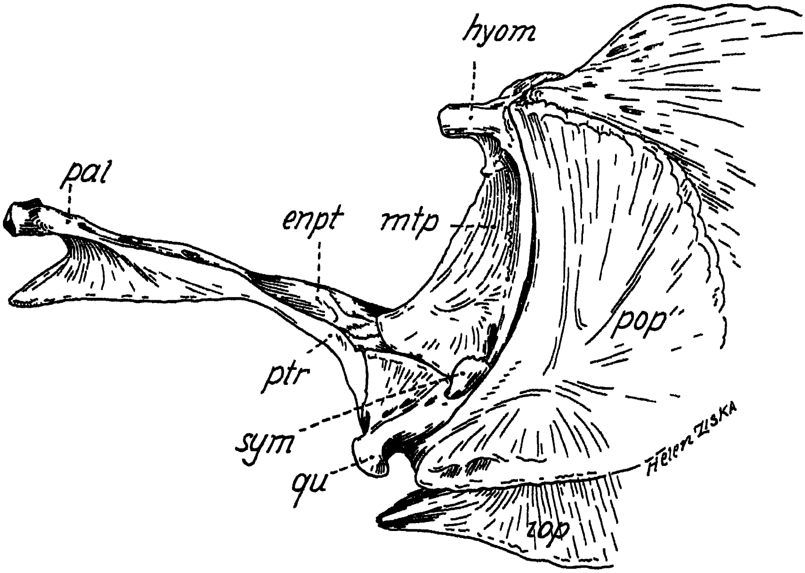

Fig 5. Primary upper jaw of *Acanthocybium*, with associated structures.

found in *Scomber*. The posterior end of the maxilla is surmounted by a fairly large supramaxillary bone. In lateral view the entire maxilla and supramaxilla are hidden by the large lacrymal.

That long pointed premaxillae are thought to be so characteristic of the genus *Acanthocybium* is an unfortunate illusion. Proportionate measurements of the length of the premaxillae show that if the dorsal length of the skull (from anterior tip of premaxillae to posterior tip of supraoccipital crest) is considered as 1.0, the length of the premaxillae anterior to the dermethmoid will be:

Scomber.	0.23
Acanthocybium.........	0.24

The palatine runs forward and hooks over the anterior end of the maxilla immediately ventral to the nasal. Along the ventral edge of the palatine there is a rather stout vertical lamina armed with very fine, minute, sharp teeth on its ventral surface. Posteriorly the palatine articulates with the entopterygoid (Fig. 5, *enpt*) and the pterygoid (*ptr*).

The pterygoid continues posteriorly to make a generous articulation in the form of a —< with the metapterygoid (*mtp*) and the quadrate (*qu*). The lower arm of the —< abuts against the entire length of the anterior edge of the quadrate, while the upper arm runs mesially to form a beveled, interdigitating articulation with the mesial surface of the metapterygoid.

The entopterygoid is a large thin bone that may be described in the words of Allis' (1903) description of *Scomber* as "shaped something like the bowl of a spoon." Anteriorly the entopterygoid is overlapped dorsally by the palatine. Along its lateral border it contacts the leg of the pterygoid Y. Its mesial and posterior edges are free from contacts.

The metapterygoid of *Acanthocybium* articulates with the hyomandibular (*hyom*) along its entire posterior and dorsal edge. Its anterior border lies free. At its ventral end it has a broad contact with the quadrate. Mesially the metapterygoid wraps a process around the column-like shaft of the hyomandibular.

The quadrate has the form of an equilateral triangle. The base of this triangle abuts against the ventral border of the metapterygoid. The apex of the quadrate triangle forms the articulation for the mandible.

The primary upper jaw of *Acanthocybium* is so close in morphology to that of *Scomber* as described and figured by Allis (1903) that one is hard put to find other than slight proportional differences between them.

The mandible of *Acanthocybium* is so very similar to that of *Scomber* that Allis' description of the mackerel mandible will apply almost word for word. *Acanthocybium* is said by Starks (1916) to possess a sesamoid articular bone. The entire dorsal border of the dentary (*den*) is armed with sharp, compressed, minutely serrated teeth. At the symphysis the two dentaries are tied together by a cap of cartilage. The symphysis of *Scomber* has no interdentary cartilage.

HYOID REGION.—The hyomandibular articulates with the neurocranium by means of two facets, one on the postero-inferior face of the sphenotic and the other on the ventral surface of the pterotic. Just ventral to the pterotic facet an articular process is developed into which the cup-shaped articulation of the opercular fits. Ventrally the hyomandibular abuts against the symplectic (*sym*), which is directed antero-ventrally, and the interhyal which is oriented along the axis of the hyomandibular shaft.

The symplectic of *Acanthocybium* is shorter and heavier than that of *Scomber,* but otherwise is essentially the same as in other Scombridae.

The interhyal articulates with the ceratohyal just above the process on the latter which articulates with a cup-like bearing on the interoperculum (*iop*). This well-developed bony cup on the mesial surface of the interoperculum which receives the articular facet of the ceratohyal is not present in *Scomber.*

The remainder of the hyoid arch of *Acanthocybium,* the hypohyal and basihyal, is not dissimilar to the conditions found in *Scomber.*

With the exception of the interoperculum mentioned above the opercular bones of *Acanthocybium* differ so little from those of *Scomber* that detailed description is unnecessary.

PECTORAL GIRDLE

The post-temporal (*ptm*) of *Acanthocybium* is a fairly stout bone connecting the pectoral girdle to the neurocranium. At its anterior end are three well-defined branches—dorsal, ventral, and median. The dorsal fork which rests on the epiotic lies in a horizontal plane and is deeply concave dorsally. The median fork lies in a vertical plane and its anterior end is made up of several spicule-like processes. The short, stout, ventral branch is directed antero-ventrally from the body of the bone. With regard to the post-temporal, according to Kishinouye, *Acanthocybium* resembles the Scombrinae more than the other Scombridae in the possession of this median branch.

There was no indication of the scale bone in our specimen of *Acanthocybium.* This bone which carries the lateral line canal on to the head is variably present in other groups of fishes, so that, while *Scomber* may possess one it is not strange that it is missing in the wahoo.

The supracleithrum (*supclthr*) is a more or less elliptically shaped bone which articulates at its dorsal end with the mesial surface of the post-temporal. Ventrally it overlaps the cleithrum (*clthr*). The anterior edge is quite thick while the posterior half of the bone is paper thin. Feebly attached to the posterior border of the supracleithrum are several very thin ossifications which apparently are postcleithra (*pclthr*).

The cleithrum is a large ∽-shaped bone in lateral view. The posterior curve bends ventrally and bears at its extremity two postcleithral bones (not figured, hidden by pectoral fin). The anterior curve is smoother and lies just mesial to the suboperculum (*sop*). The posterior arc is flat and |-shaped in section whereas the anterior portion is folded upon itself so as to be ∩-shaped in section. The lateral wing of this ∩ is wider than the mesial wing, but is parallel to it for its entire length as in other Cybiidae.[1] In the Thunnidae, on the other hand, this lateral wing is at a right angle to the mesial wing.

The coracoid (*cor*) is articulated antero-dorsally with the cleithrum and dorso-posteriorly with the scapula (*scap*). The coracoid overlaps anteriorly the lateral surface of the mesial wing of the cleithrum. A large foramen is left between its dorsal articulation with the cleithrum and the antero-ventral overlap of the coracoid on the cleithrum. This foramen is large, according to Kishinouye, in both *Acanthocybium* and *Gymnosarda* while in *Cybium* (*Scomberomorus*) and *Sarda* it is small.

PELVIC GIRDLE

The pelvic girdle of *Acanthocybium* is moderately developed and resembles the condition described by Kishinouye (1923) as typical for the Cybiidae.

VERTEBRAL COLUMN

The vertebral column of the Scombridae, like that of many teleosts, may be divided conveniently into several regions. The average form of each region differs considerably from the average form of any other region. At the extremities of each region there is a gradual transition from one form to the other. There are six such regions in *Acanthocybium* which may be described as follows (see also Table II):

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[1] The Cybiidae is a family of Scombriformes erected by Kishinouye in 1915

1.—The post-cranial vertebrae characterized by stout neural arches and spines.

2.—The "mesabdominals" follow the post-cranials, bear ribs, but do not possess haemal arches.

3.—The posterior abdominals have closed haemal arches and bear ribs.

4.—The anterior caudals resemble greatly the posterior abdominals except that thay have lost the ribs and have developed haemal spines.

5.—In the "tail segment" the vertebrae have their neural and haemal spines entering into the support of the caudal fin.

6.—The hypural complex is an almost symmetrical fan which receives the rays of the caudal fin.

This basic plan of vertebral form is to be found in *Scomber* which has 31 vertebrae; in *Cybium* (*Scomberomorus*) *koreanum* which has 46; and in *Acanthocybium*, with its vertebral formula of 23–33 + 31–34 = 54–66.

That these rather closely related genera, with a common plan of backbone, differ so widely in vertebral counts substantiates Ford's (1937) observation that too great a dependence upon "number of vertebrae" will often separate backbones which are obviously similar in form.

The vertebral column of *Acanthocybium* is the longest to be found among the Scombridae. Such a many segmented column may indicate that the wahoo has a more sinuous locomotor habitus than is to be found among the Scombridae generally.

Abdominal Vertebrae

The abdominal vertebrae of *Acanthocybium* (Fig. 6) are quite variable in their form. The first vertebra bears no rib, but the second bears both a pleural and an epipleural rib. The epipleurals are found articulated to the head of the broad pleural rib on all of the anterior vertebrae from the second to the tenth inclusive. "In this respect," according to Starks (1910), "*Acanthocybium* differs from all of the other genera, as in the others all of the epipleurals are on the centra."

All of the abdominals bear more or less strongly developed anterior and posterior neural zygapophyses. The anterior neural zygapophysis is peculiarly developed with a tiny slot (Fig. 6, "x") into which fits the posterior zygapophysis of the preceding vertebra. This interlocking arrangement is not of the same design as that in *Istiophorus* (see Gregory and Conrad, 1937, p. 10), for in the latter the right and left anterior zygapophyses together form a slot into which fits the neural spine of the vertebra in front Thus a similar mechanical effect, the strengthen-

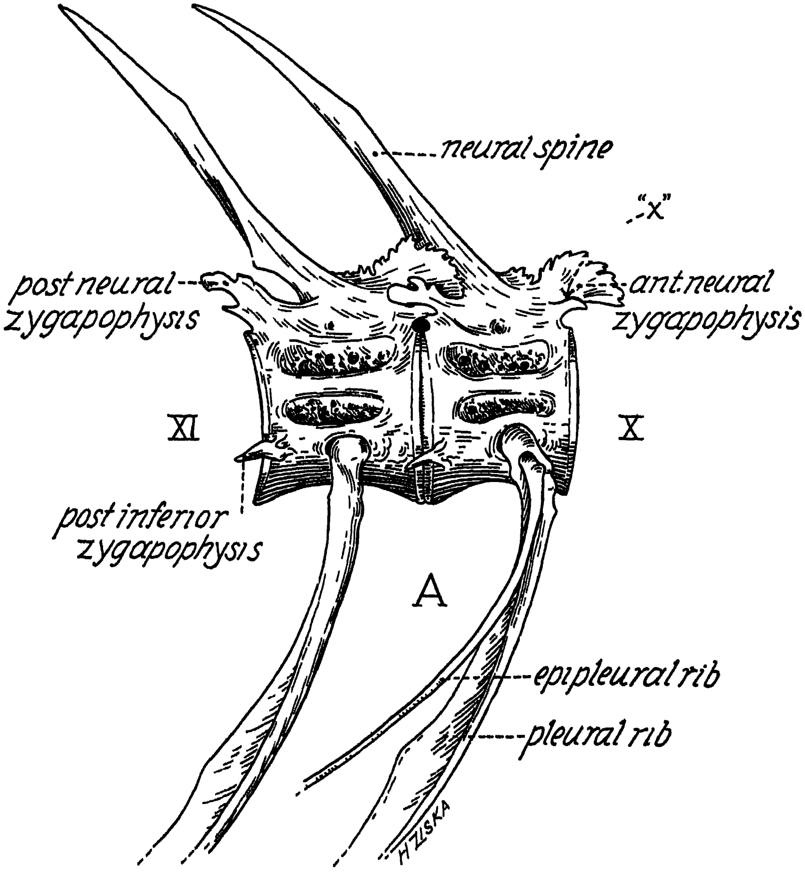


Fig. 6. Abdominal vertebrae of *Acanthocybium*.

ing of the column, is arrived at by different means in these two scombroid genera.

A postero-inferior zygapophysis is developed in *Acanthocybium*. The eighth vertebra is the first one on which such a perceptible haemal zygapophysis is noticed. This posterior haemal zygapophysis arises from the bony septum between the ventral and median lateral fossae of the centrum in the anterior abdominals, but as the centra deepen and the ventral fossae become more pronounced the posterior haemal zygapophyses move to the ventral border of the ventral fossa. In the more anterior abdominals this zygapophysis may serve to stiffen the column.

The neural spine of the first vertebra is not attached (*autogenous*) to its centrum. The neural arches and spines of the first five or six vertebrae are stoutly developed with an antero-posterior emphasis. The neural spine of the seventh is perceptibly the shortest of those on the abdominal vertebrae and from this point until a peak is reached on the 37th vertebra, under the second dorsal fin, they become progressively longer.

Haemal parapophyses are sufficiently developed to be first noticed on the sixteenth vertebra. From that point backward they become increasingly long until, on the twenty-seventh vertebra, they meet in the mid-ventral position to form a closed haemal arch. The next five vertebrae (27th to 31st, inclusive), although bearing true haemal arches are to be considered as abdominals for they all bear pleural ribs.

The abdominal centra of *Acanthocybium* are "square" and heavily sculptured with deep fossae in lateral aspect. The more anterior abdominals have but two deep fossae—a dorsal and a median—dorsal to the rib facet. In the posterior abdominals as the parapophyses approach the antero-ventral border of the centra a ventral fossa is developed. The remainder of the centra are characterized by these three deep lateral fossae until on the fifty-sixth vertebra of the caudal series the median fossa is swamped out. In the possession of three lateral fossae per centrum *Acanthocybium* differs from all other Scombridae except *Cybium* (*Scomberomorus*) *koreanum*. Kishinouye's figure of *Cybium* (*Scomberomorus*) *chinense* shows incipient median fossae in the caudal vertebrae.

Caudal Vertebrae

The anterior caudal vertebrae of *Acanthocybium* (Fig. 7) are very similar to the most posterior abdominals, except that the haemal arch develops a spine and the ribs and rib facets are eliminated.

The arrangement of the neural zygapophyses is exactly as in the abdominal vertebrae.

There are stoutly developed anterior and posterior haemal zygapophyses which oppose each other but do not overlap. There is no slot-like mechanism devised to stiffen the ventral side of the column.

More posteriorly, the fifty-seventh vertebra (Fig. 8A), presents a much modified condition. Here the dorsal and ventral fossae are very deep pits, while the median fossa is becoming eliminated. The entire surface of the centrum is covered with the most intricate filigree work which may serve to lighten the structure while preserving its strength. In common with all the scombroids the neural and haemal spines and arches of *Acanthocybium* are noticeably flattened down in the "peduncle" region. This has resulted in the loss of both the posterior neural and haemal zygapophyses, while anteriorly the neural and haemal zygapophyses have been much reduced. The lateral ridges are not expanded to form bony lateral keels in the peduncle region as in the tunas.

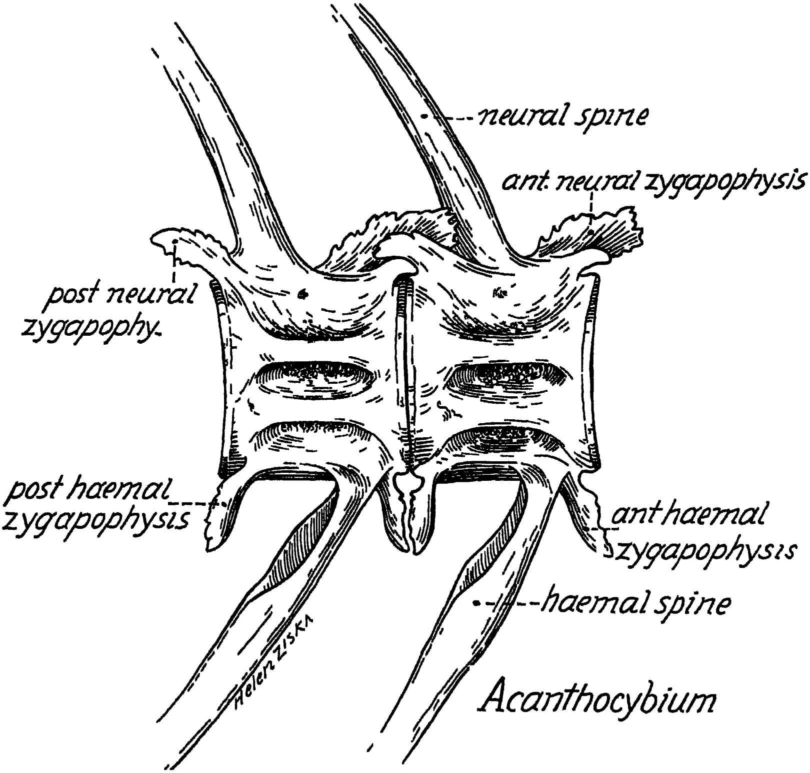


Fig 7 Caudal vertebrae of *Acanthocybium*

Hypural Complex

The nomenclature of the description that follows is based upon the system suggested by Whitehouse (1910).

The last four vertebrae (58th to 61st, inclusive) preceding the hypural fan (62) enter into the support of the caudal fin. The neural spines of the 58th, 59th, 60th, and 61st form a series of epurals Between the epurals and the hypurals is a group of three autogenous dorsal caudal radials (Fig 8B). The hypural fan of the 62nd vertebra is spread symmetrically both dorsally and ventrally The haemal spines of the vertebrae 58th to 61st, inclusive, all serve to help support the caudal fin so may be considered as hypurals.

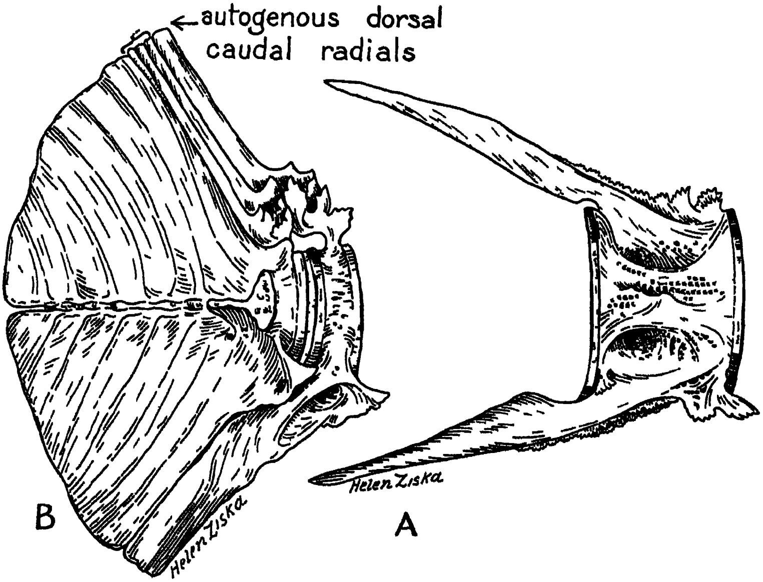


Fig 8 *Acanthocybium.* A, 57th vertebrae; B, hypural complex

In form and arrangement the hypural complex of *Acanthocybium* resembles that of *Cybium* (*Scomberomorus*) more than it does the primitive *Scomber.* However, the hypurals arising from the penultimate and antepenultimate vertebrae of *Cybium* (*Scomberomorus*) *chinense,* from Kishinouye's (1923) figures, seem to be autogenous whereas in *Acanthocybium* the hypurals are fused to their respective vertebrae. In *Gymnosarda,* on the other hand, the ventral elements are fused with their respective vertebrae and are thus true hypurals. There are several dorsal caudal radials present in *Cybium* (*Scomberomorus*), but none in *Gymnosarda* While the posterior notch in the hypural fan is prominent in *Cybium* (*Scomberomorus*) and not so marked in *Acanthocybium* the general form of the fan is not dissimilar.

In *Scomber scombrus,* according to Ford's (1937) figure, the hypurals of the penultimate and the antepenultimate vertebrae are autogenous. The shape of the fan is much less symmetrical than in *Acanthocybium* or *Cybium* (*Scomberomorus*). There is a well-defined epural appressed but not fused to the dorsal hypural. There is no evidence of this in either *Acanthocybium* or *Cybium* (*Scomberomorus*) in which the hypurals are separated from the epurals by dorsal caudal radials.

Gill (1863), Lütken (1880), Jordan and Evermann (1896), and many other authors have concurred in placing the wahoo, *Acanthocybium solandri*, among the Scombridae as understood in the broad sense. Starks (1910) published a phylogenetic tree which shows *Acanthocybium* as an offshoot of *Scomberomorus* (*Cybium*). Kishinouye (1923) placed *Acanthocybium* in his family Cybiidae which includes the genera often known as Spanish and King mackerels. Most authors, however, sink Kishinouye's Cybiidae in the Scombridae.

Study of the osteology of *Acanthocybium* seems to indicate that these previous authors have been correct in considering it to be an aberrant but definite member of the Scombridae.

RELATIONSHIPS WITH THE XIPHIIFORMES

Does the genus *Acanthocybium* form a connecting link between the Scombridae and the Xiphiiformes? Such a belief is implied by the following statements of Lütken, Jordan and Evermann, Starks, and Kishinouye.

Lütken (1880), as translated by Bean in Goode's 'Materials for a history of the swordfishes' (1883), makes the following statement:

> Despite certain analogies between *Xiphias* and *Histiophorus* at their appearance from the egg, there are very considerable differences between them in their very first conduct differences which show well enough that the separation between these two genera is rather wide. To this result one must come also by comparison of the bony structure of a *Histiophorus* or a *Tetrapturus* with that of a *Xiphias*. The closest generically of the *Histophori*, especially of the *Terapturi*, we will in a later section, find in the genus *Acanthocybium*, which presents decided resemblances. If these show nothing more than a very close relationship, they at any rate unite the tie too firmly for one to regard the Xiphioids as other than a subsection of the great mackerel family.

In a French résumé of his article, 'Spolia Atlantica. . . . ,' Lütken has the following to say about *Acanthocybium:*

> That *Acanthocybium* is the Thynnoid form most nearly approaching the swordfish is shown by the peculiar modification of the branchiae and the prolongation of the intermaxillaries [premaxillaries], which, if more developed, would become the short rostrum of *Tetrapturus belone*. The genus thus acquires peculiar importance

from a systematic point of view; and a detailed investigation of the still unknown structure of its skeleton would be especially desirable.

Jordan and Evermann (1896) in their 'Fishes of North and Middle America' make the statements below:

> This remarkable genus [*Acanthocybium*] indicates a long step from *Scomberomorus* toward the type of the swordfishes.
>
> This group [Istiophoridae] represents a younger stage in the development of *Xiphias*, and is intermediate between the latter and the scombroid stock, from which both are derived. The gaps are wide in the series *Scomberomorus*, *Acanthocybium*, *Istiophorus*, *Tetrapturus*, *Xiphias*, but the natural sequence seems evident.

Starks (1910) in his paper on the 'Osteology and mutual relationships of the fishes belonging to the family Scombridae,' says:

> *Acanthocybium* naturally comes next to *Scomberomorus* though ..... it certainly does not deserve a position so close to *Scomber*. It shows, as was long ago pointed out, an apparent divergence toward the swordfishes.

Kishinouye, more recently (1923), says:

> This family [Cybiidae] is related on one hand to the Xiphiidae in the reticulate gills, absence of gill-rakers, small narrow scales, etc. through the genus *Acanthocybium*. . . . . . .

Later in the same paper under the generic description he says:

> This genus [*Acanthocybium*] comprises a rather aberrant form, more or less related to the Xiphiidae.

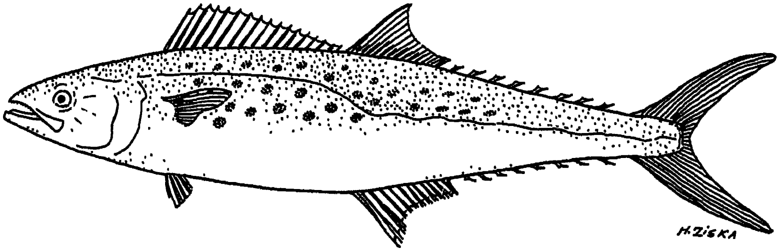
Despite this belief that *Acanthocybium* points the way to the Xiphiiformes, none of the authors quoted have gone so far as to remove this genus from the Scombridae (in the broad sense) and place it with either the Istiophoridae or Xiphiidae. That it is an aberrant side branch of the Scombriformes is unquestioned, but it seems extremely doubtful that it diverges from the Scombridae in the direction of the Xiphiiformes.

Nevertheless an extended comparison of *Acanthocybium* with the xiphiiform genera will either substantiate or eliminate the concept expressed by the several authors above.

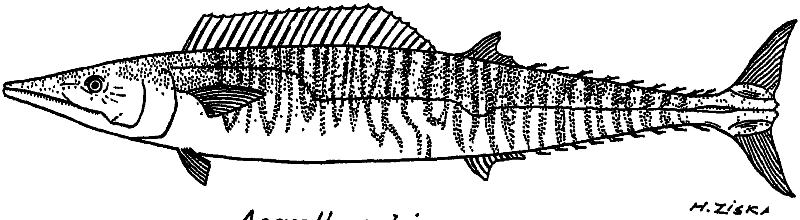
Body and Fin Form

The bases upon which the wahoo (*Acanthocybium solandri*) has been so continuously linked with the Xiphiiformes are but vaguely suggested in the literature examined. Its elongate body; its long dorsal fin; the prominent beak; all these features, coupled with the peculiar modification of the branchii in *Acanthocybium* and *Xiphias*, as alluded to by Lütken (1880), have probably given rise to this opinion.

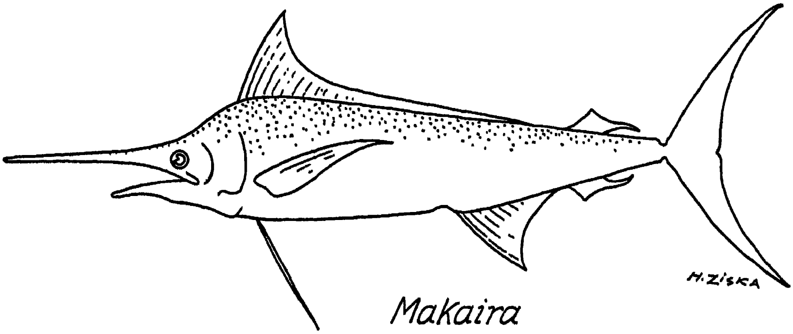
A more detailed analysis of the body form fails to show how such an assumed relationship could exist. It is evident at once from figure 9



Scomberomorus



Acanthocybium



Makaira

Fig. 9. Body forms of *Scomberomorus*, *Acanthocybium*, and *Makaira*.

that *Acanthocybium* more nearly resembles *Scomberomorus* than *Makaira*. The long, low first dorsal seen in *Acanthocybium* is noteworthy in the Scombridae, whereas in the Xiphiiformes there is a strong tendency to emphasize the anterior portion in the Istiophoridae and lose the posterior part in the Xiphiidae. The finlets of the second dorsal region which

TABLE I.—Comparison of the Body Forms of *Scomber*, *Scomberomorus*, *Acanthocybium*, and *Makaira*.

Indices	*Scomber colias*	*Scomberomorus maculatus*	*Acanthocybium solandri*	*Makaira nigricans ampla*
Body length $\frac{\text{length} \times 100}{\text{depth}}$	Mesosomatic 477%	Mesosomatic 463%	Dolichosomatic 652%	→ Dolichosomatic 631% Mesosomatic 453%
Body width $\frac{\text{width} \times 100}{\text{depth}}$	Mesothoracic 71%	Mesothoracic 50%	← Mesothoracic 68%	→ Mesothoracic 60% Stenothoracic 40%
Head length $\frac{\text{head length} \times 100}{\text{body length}}$	Nomocephalic 28%	Nomocephalic 23%	← Nomocephalic 24%	Macrocephalic 36%
Head depth $\frac{\text{head depth} \times 100}{\text{head length}}$	Mesocephalic 62%	Mesocephalic 64%	Platycephalic 48%	→ Platycephalic 29%
Head width $\frac{\text{head width} \times 100}{\text{head depth}}$	Mesocranial 65%	Mesocranial 67%	← Mesocranial 76%	→ Mesocranial 70%
Snout length $\frac{\text{snout length} \times 100}{\text{head length}}$	Nomorhynchal 31%	Nomorhynchal 40%	← Nomorhynchal 50%	Hypermacrorhynchal 66%
Upper jaw length $\frac{\text{upper jaw} \times 100}{\text{head length}}$	Mesognathic 38%	Macrognathic 57%	Mesognathic 49%	Macrognathic 78%
Eye $\frac{\text{eye length} \times 100}{\text{head length}}$	Mesophthalmic 22%	Microphthalmic 12%	← Microphthalmic 10%	→ Microphthalmic 6%
Gill chamber $\frac{\text{length preop. to operc.} \times 100}{\text{head depth}}$	Mesocameral 51%	Mesocameral 47%	← Mesocameral 54%	→ Mesocameral 64%
Peduncle vertical $\frac{\text{min. depth peduncle} \times 100}{\text{body depth}}$	Leptopygidial 15%	Leptopygidial 19%	← Leptopygidial 21%	→ Leptopygidial 19%

Peduncle width $\frac{\text{peduncle width} \times 1}{\text{peduncle depth}}$	Eurypygidial 96%	Eurypygidial 157%	← Eurypygidia 104%	→ Eurypygidial 80% ±
First dorsal length $\frac{\text{fin length} \times 100}{\text{body length}}$	Medibasic 16%	Longibasic 26%	← Longibasic 33%	→ Longibasic 48%
First dorsal height $\frac{\text{fin height} \times 100}{\text{body depth}}$	Mediradial 60%	Breviradial 29%	← Breviradial 21%	Altiradial 89%
Second dorsal length $\frac{\text{fin length} \times 100}{\text{body length}}$	Medibasic 28%	Longibasic 42%	Medibasic 30%	Perbrevibasic 4%
Second dorsal height $\frac{\text{fin height} \times 100}{\text{body depth}}$	Breviradial 25%	Mediradial 45%	← Mediradial 35%	Breviradial 21%
Anal length $\frac{\text{fin length} \times 100}{\text{body length}}$	Medibasic 26%	Longibasic 40%	Medibasic 27%	→ Medibasic 23%
Anal height $\frac{\text{fin height} \times 100}{\text{body depth}}$	Breviradial 25%	Mediradia 49%	← Mediradial 42%	Longiradial 78%
Pectoral fin length $\frac{\text{fin length} \times 100}{\text{body length}}$	Breviradial 11%	Breviradi 12%	← Breviradial 11%	Mediradial 20%
Pelvic fin spread $\frac{\text{fin spread} \times 100}{\text{body length}}$	Parviareal 2.9%	Parviareal 4%	← Parviareal 3%	→ Parviareal 0.4%
Pelvic fin length $\frac{\text{fin length} \times 100}{\text{body length}}$	Breviradial 9%	Breviradi 5%	← Breviradial 3%	Mediradial 13%
Caudal fin length $\frac{\text{fin length} \times 100}{\text{max. spread caudal}}$	Brachycerc 140%	Brachyce 22%	← Brachycerc 34%	→ Brachycercal 20%
Caudal fin spread $\frac{\text{fin spread} \times 100}{\text{body depth}}$	Macrocerc 114%	Hyperma 167%	← Hypermac 173%	→ Hypermacrocercal 217%

are so characteristic of the Scombridae are seen in *Acanthocybium*, but not in *Makaira*. The pelvic fins of both *Acanthocybium* and *Scomberomorus* are quite robust and apparently quite functional; in *Xiphias*, they are completely lost; and, in the Istiophoridae, they are so long and thin as to seem incapable of locomotor function. The caudal fin of *Acanthocybium* lacks the deep concavity of the Scombridae, in this regard resembling the typical *Makaira*. The most striking difference between *Acanthocybium* and the Xiphiiformes is the prominent beak of the latter. This last difference is, however, only one of degree, for the rostrum is merely an elongation of the premaxillaries.

Table I compares the body form details of *Scomberomorus*, and *Scomber*, representing the Scombridae; *Makaira nigricans ampla*, representing the Xiphiiformes; and *Acanthocybium solandri*. The table is based on material published by Conrad and La Monte (1937) and a series of unpublished measurements made by Dr. William K. Gregory on the Arcturus Expedition of the New York Zoological Society in 1925. The definitions of the body form terms are those given by Gregory (1928 *b*).

It will be seen from a study of Table I that *Acanthocybium* resembles *Scomberomorus* in seventeen characters and *Makaira* in thirteen. Ten of these characters are common to all three and are undoubtedly an indication of their mutual scombroid heritage. Thus, in head length, snout length, first and second dorsal fin height, anal fin height, and pectoral and pelvic fin length *Acanthocybium* resembles *Scomberomorus;* whereas in body length, head depth, and anal length the wahoo resembles *Makaira.*

The long sword of *Makaira* so prejudices the measurement of body length that comparisons with *Acanthocybium*, and other forms, are profoundly affected. Gregory and Conrad (1937) noted that if the sword was arbitrarily eliminated from consideration in *Xiphias* the body length was mesosomatic. Conrad and La Monte (1937) found that some of their *Makaira* were mesosomatic while others were dolichosomatic with the swords included; without the sword all were definitely mesosomatic. Thus, the fundamental mesosomy of the Xiphiiformes, a scombroid heritage, is masked by their prominent rostra.

Just as the sword of the xiphiiform fishes influences the length classification, so does it influence the relative depth of the head. With the sword eliminated the depth of head in *Makaira* is mesocephalic as in *Scomberomorus* and other scombroids.

The long pointed snout is considered characteristic of *Acanthocybium.* However, as is shown above (p. 9), the premaxillaries are not inordinately long. Whence comes this appearance? In the first place, the head of *Acanthocybium* is very long (about one-fourth of the total body length), secondly, the head is very shallow, or platycephalic. Such a long and low head must give the impression of a sharply pointed snout. In contrast is *Scomberomorus* with its deeper, or mesocephalic, character. The snout of *Scomberomorus* is but moderately pointed and the entering angle is somewhat greater than in *Acanthocybium.*

This body form analysis suggests that *Acanthocybium,* although unique among Scombridae in its extreme length and shallow depth, is essentially one of the Scombridae and without affinities to the Xiphiiformes.

This extremely long, arrow-like body must be admirably streamlined for it has been recorded as traveling at a speed of 41 miles per hour (Howell, 1937), a speed far in excess of that of other fishes so measured.

OSTEOLOGY

In the discussion below on the possible relationships of *Acanthocybium* to the Xiphiiformes as evidenced by its osteology, many references will be made to the conditions to be found in *Istiophorus* and *Xiphias.* In the interests of simplicity, however, as few details of xiphiiform osteology as possible will be mentioned. For further details the reader is referred to two recent papers in which observations on the osteology and relationships of *Xiphias* and *Istiophorus* were made (Gregory and Conrad, 1937; Conrad, 1937). It may be mentioned here, however, that the skeletons of all of the Istiophoridae (*Istiophorus*, *Makaira*, *Tetrapturus*) are essentially alike.

Skull

Any comparison of the skulls of various scombroids must take into account those resemblances which are the fundamental heritage of all members of the group. Regan (1909) listed the following characters, among others, as basic to all scombroids:

(1) Maxillaries more or less firmly attached to the non-protractile premaxillaries which are typically produced and pointed anteriorly.
(2) Cranium with orbito-rostral portion elongate and postorbital portion abbreviate.
(3) Parietals separated by supraoccipital.
(4) No orbitosphenoid.
(5) Basisphenoid present.
(6) Proötics giving rise to an osseous roof for the myodome.

Another common feature of all of the scombroids is the large size of the opercular bones.

As is indicated by the list of heritage characters above, the neurocrania of *Xiphias*, *Istiophorus*, and *Acanthocybium* are all very similar fundamentally. The arrangement of the crests is similar in all of them and differs only in proportions. The position of the nasal bone in *Acanthocybium* is more like that in *Istiophorus* than *Xiphias*. In *Istiophorus* and *Acanthocybium* the nasal is large and robust and receives some of the thrust of the upper jaw whereas in *Xiphias* the nasal is a very small vestige receiving no stresses or strains.

Lütken (see above, p. 17) suggested that *Acanthocybium* could be more readily compared with the Istiophoridae than with *Xiphias*. In the character of the suspensorium this is certainly true, for the anteroposterior dimension of the metapterygoid is similarly great in both *Istiophorus* and *Acanthocybium* while in *Xiphias* this same dimension is very much reduced. The symplectic is prominent in lateral view in both the wahoo and the sailfish, but is hidden from view by the quadrate in *Xiphias*. The quadrate of *Acanthocybium*, however, is of the primitive triangular type noted in *Scomber* and *Xiphias* with no evidence of the quadrilateral tendency seen in *Istiophorus*. The pterygoid of *Acanthocybium* has a firm and broad abutment against the entire anterior wall of the quadrate, even extending dorsad and mesially onto the metapterygoid. Such an extensively braced condition more nearly resembles the istiophorids than *Xiphias*, for in the latter only a point contact exists between the pterygoid and the most anterior angle of the "quadrate triangle." The entopterygoids of both *Acanthocybium* and *Istiophorus* are developed mesially into a rather broad plate, but in *Xiphias* the entopterygoid is quite narrow. The palatine of the wahoo is very much as in *Istiophorus* passing forward as it does to hook over the anterior end of the maxilla immediately beneath the nasals.

Of course the most striking specialization of both the Istiophoridae and the Xiphiidae is the possession of long, sword-like premaxillaries. Conrad (1937) showed that the swords of both families, while differing in details, are fundamentally alike for they consist chiefly of hypertrophied premaxillae. Regan (1909) implied by diagram that *Acanthocybium* was the primitive stage in the development of the rostrum. But certainly *Acanthocybium* is no nearer the condition in the Xiphiiformes than is *Scomber*. Either of these fishes could be the starting point of a structural series of scombriform rostra leading to the swordfishes, but it seems doubtful that *Acanthocybium* is a genetic precursor of any of the Xiphiiformes, either in this character or any other.

In *Xiphias* the articular is the dominant element of the mandible; in *Makaira* it is less so; while in *Scomber* and *Acanthocybium* both the dentary and the articular contribute more or less equal amounts. An angular bone is present in *Acanthocybium* which is visible in lateral view whereas the angulars of *Xiphias* and *Makaira* are almost completely mesial and cannot be seen in lateral aspect. As in *Acanthocybium*, a sesamoid articular bone is present in the xiphiiform fishes. The predentary bone which is present in the Istiophoridae is absent in both *Xiphias* and *Acanthocybium.*

The arrangement of the opercular bones of *Acanthocybium* differs considerably from those in either *Makaira* or *Xiphias.* The preoperculum is proportionately larger in the wahoo than in any of the Xiphiiformes. The preoperculum of *Acanthocybium* has a somewhat rectangular form, while that of *Makaira* or *Istiophorus* has a crescent shape. The preopercle of *Xiphias* has become so narrow antero-posteriorly as to be a relative sliver. The operculum of *Acanthocybium* seems nearer to that of *Makaira* than to *Xiphias*, for the antero-inferior corner is projected ventrally until it almost makes contact with the interoperculum, while in *Xiphias* the antero-inferior corner of the opercle is rounded and does not meet the interoperculum. The subopercula of the wahoo and *Scomber* are quite large and project dorsally farther than in the Xiphiiformes. The interoperculum of *Acanthocybium* with its marked antero-posterior elongation is similar to that of *Scomber.* This contrasts with the dorso-ventral emphasis of the interoperculum in the xiphiiform fishes.

Comparison of the skulls of *Acanthocybium*, *Istiophorus*, and *Xiphias* indicates that most of the specializations of the Xiphiiformes are in the secondary upper jaw and other differences were probably brought about to meet altered stresses developing with the evolution of the sword. However, the general similarity of the neurocrania reflects only a common scombroid heritage and does not provide a clue to the phylogeny of the Xiphiiformes.

Vertebral Column

Lütken (see above, p. 18), in considering the relationship of *Acanthocybium* with the Xiphiiformes, was sufficiently cautious to suggest that the post-cranial skeleton be studied before a final disposition of *Acanthocybium* was made. It is in the vertebral column (which Lütken apparently did not have) that the answer to the problem of the relationships of *Acanthocybium* seems to lie.

The vertebral column of *Acanthocybium* is long and many segmented, some individuals having as high as sixty-six vertebrae. *Xiphias* and *Istiophorus* have much shorter columns with fifteen precaudals and eleven caudals in the swordfish while the latter genus has twelve precaudals and twelve caudals to make a total of twenty-four. Thus, the recent Xiphiiformes have the least number of vertebrae of any of the scombroids, whereas *Acanthocybium* has the largest number among the members of the Scombridae. This is a quantitative contrast which is unfortunately broken down when *Palaeorhynchus*, a Lower Oligocene sailfish, is examined. *Palaeorhynchus* has about sixty vertebrae.

Light can be thrown on this problem of the relationships of *Acanthocybium* with the xiphiiform fishes only by an analysis of the qualitative characters of the individual vertebrae (Tables II, III, IV) for, as was pointed out above (p. 12), too great a dependence on vertebral counts may often separate backbones which are quite similar in morphology. In this case, however, it seems that not only are the counts dissimilar but also the morphology.

Under the discussion of the vertebral column of *Acanthocybium* we found that the column could be divided into six quite definite regions. Let us compare these regions in the wahoo with their homologues in the Xiphiiformes.

I.—The post-cranial vertebrae of *Acanthocybium* were characterized by stout neural arches and spines and were about six in number. In both *Xiphias* and *Istiophorus* the true post-cranials are only two in number. These post-cranials are so different in form from each other and from the remainder of the vertebrae as to give the appearance of a pseudo atlas and axis arrangement. The first vertebra in the Xiphiiformes articulates with the exoccipitals by means of two dorso-lateral facets. In *Istiophorus* and *Xiphias* the first post-cranial bears a rib whereas in *Acanthocybium* this is lacking. The neural arch is present in the first post-cranial of *Istiophorus*, but no spine is developed. There is an indication of a posterior neural zygapophysis in *Istiophorus*. In *Xiphias* a neural spine is present on the first post-cranial as well as a posterior neural zygapophysis. The second post-cranial of *Istiophorus* bears a pleural rib, has both an anterior and a posterior neural zygapophysis, but has no neural spine developed. In *Xiphias* the second post-cranial may be described in the same manner as for *Istiophorus*.

II and III.—The remainder of the abdominal vertebrae of the Xiphiiformes cannot be divided into "mesabdominals" and posterior abdominals for they are all remarkably alike in form. None of the abdominal centra of either section of the Xiphiiformes possess the closed haemal arch which is so typical of the Scombridae. *Istiophorus* bears ribs on all abdominals and post-cranials, but in *Xiphias* ribs are borne only on the two post-cranials and on the first two and last three abdominal vertebrae. *Acanthocybium* bears ribs on all abdominals and on all post-cranials, but the first. However, no xiphiiform fish bears epipleural ribs, while they are present in most Scombridae, including *Acanthocybium.*

As noted above (p. 12) the interlocking of the vertebrae by means of the zygapophyses is seen to a marked degree in both *Acanthocybium* and *Istiophorus*, but the details of design are fundamentally different. *Xiphias* shows this interlocking only to a slight degree, but it is readily comparable to the system used in *Istiophorus.*

The most striking specialization in the column of *Istiophorus* (Gregory and Conrad, 1937, Fig. 4) is the large, antero-posteriorly developed, flange-like neural spines which are accompanied by long, thin, horizontally placed anterior neural zygapophyses. In *Xiphias* (Gregory and Conrad, 1937, Fig. 4) the neural spines are long and compressed slightly, while both anterior and posterior neural zygapophyses are well developed, but rise obliquely rather than horizontally from the centra. In *Acanthocybium* the neural spines are long and tapering to a point and the neural zygapophyses are moderately developed.

IV.—The caudal vertebrae of *Xiphias* and *Istiophorus* are quite uniform. However, in both of these xiphiiform types there is a more abrupt jump from the abdominals to the caudals than in *Acanthocybium.* This, of course, is because no haemal arches are formed in xiphiiform fishes until the caudal region starts.

In *Istiophorus* the haemal arch and spine is a counterpart of the neural elements—the same interlocking scheme being used. In *Xiphias,* while the haemal spines resemble the neural spines, the haemal zygapophyses are poorly developed in the caudal region. In *Acanthocybium* the neural elements are as in the abdominals, but the haemal zygapophyses, although very well developed, merely oppose each other and do not interlock.

The centra of *Acanthocybium* are "cuboid" and heavily sculptured by deep lateral fossae. The anterior abdominals have dorsal and median fossae and as one passes posteriorly a ventral fossa is added. The median fossa is eliminated in the posterior caudals. *Xiphias* likewise has a "cuboid" centrum in the abdominal region, with a tendency for the centra to lengthen in the caudal region. However, *Xiphias* shows none of the "sculpturing" seen in *Acanthocybium* and other Scombridae. In fact the surface is so plain and rather concave that one gets the impression of "degeneracy." As an opposite extreme the typical centrum in *Istiophorus* is long and hour-glass shaped with a certain amount of sculpturing.

V and VI.—The hypural complex remains to be discussed. Each of these forms has a homocercal tail, and in each the hypural fan which is the major support of that tail is almost perfectly symmetrical. As was noted above, the last five vertebrae (including the hypural fan) in *Acanthocybium* all enter into the support of the caudal fin, but in both *Xiphias* and *Istiophorus* only the last two vertebrae are concerned.

The vertebrae of the Xiphiiformes are of two definite types neither of which is comparable to those of *Acanthocybium.* Regan (1909) and Gregory and Conrad (1937) showed that the two modern families of swordfishes, the Xiphiidae and the Istiophoridae, may be traced back to the Eocene form *Blochius* and the Lower Oligocene *Palaeorhynchus*, respectively. Characteristic of the *Xiphias-Blochius* line are squarish, cuboid centra unrelieved by surface sculpturing, with short ribs, and with none of the antero-posterior emphasis seen in *Istiophorus.* The istiophorid-*Palaeorhynchus* line is characterized by an extreme antero-posterior development of the centra, neural, and haemal spines, and the zygapophyses. It was concluded that the xiphiiform fishes represented two distinct but parallel lines of scombroid evolution.

TABLE II.—A Synopsis of the Vertebral Column of *Acanthocybium solandri.*

Serial number of vertebrae	Characteristics
1	**Post-cranial.** Neural arch and spine autogenous but large.
2–6	**Post-cranial.** Neural spines robust, slightly laminated.
7–26	**Mesabdominals.** Neural spines round, tapering to a point. No haemal arches.
27–32	**Posterior abdominals.** Haemal arches with ribs, no spines.
33–57	**Caudals.** Haemal arches and spines.
58–60	**Tail segment.** Haemal and neural spines support caudal fin.
61	**Tail segment.** Neural spine autogenous.
	Three dorsal caudal radials between the 61st and 62nd vertebrae.
62	**Hypural fan.**

TABLE III.—A Synopsis of the Vertebral Column of *Istiophorus.*

Serial number of vertebrae	Characteristics
1	**Post-cranial.** Neural arch nearly fused over; no neural spine; no anterior neural zygapophysis.
2	**Post-cranial.** Neural arch not fused; no neural spine; anterior neural zygapophysis well developed. Neural arch not laminate.
3–4	**Abdominals.** Neural arches laminate, not fused into a spine.
5–12	**Abdominals.** Neural arches fused into a spine.
13	**Caudal.** Haemal arch and spine; no anterior haemal zygapophysis.
14–21	**Caudals.** As in 13th but with anterior haemal zygapophyses.
22	**Caudal.** Neural and haemal spines losing laminate character; haemal arch and spine autogenous.
23	**Tail segment.** Neural and haemal arches and spines autogenous.
	Two dorsal caudal radials between 23rd and 24th vertebrae.
24	**Hypural fan.**

TABLE IV.—A Synopsis of the Vertebral Column of *Xiphias gladius*

Serial number of vertebrae	Characteristics
1	**Post-cranial.** Neural arch not fused over (directed dorsally); no neural spine; no anterior neural zygapophysis; short centrum.
2	**Post-cranial.** Neural arch and anterior neural zygapophysis exceedingly robust; neural arch not fused; arch and zygapophysis rise obliquely anteriorly and posteriorly. Centrum longer than deep.
3–7 or 8	**Abdominals.** Neural arches and zygapophyses less robust but similar to 2nd; arches not fused into spine. Cuboid centra.
9–15	**Abdominals.** Neural arches fused to form spine. Cuboid centra.
16–24	**Caudals.** Haemal arches and spines developed. Spines become progressively shorter; centra progressively longer.
25	**Tail segment.** Neural and haemal spines and arches autogenous.
	Three dorsal and one ventral caudal radials interposed between 25th and 26th vertebrae.
26	**Hypural fan.**

Examination of these three columns—*Acanthocybium*, *Xiphias*, and *Istiophorus*—leaves one with the impression that we are dealing with very different forms (Tables II, III, IV). There is no doubt that *Acanthocybium* has definite affinities with the Scombridae for the form of the individual vertebra is of the scombrid type—more or less cuboid in shape, with well-marked lateral fossae, and, as in many mackerels and tunas, with the haemal arch developed over the posterior part of the abdominal cavity. All of these characters and more are lacking in the xiphiiform fishes.

SUMMARY

A study of the osteology of the highly specialized scombroid, *Acanthocybium solandri*, substantiates the work of previous authors in placing it in the family Scombridae.

Prolonged consideration of its alleged relationship to the xiphiiform fishes brings out the following points:

1.—*Acanthocybium* is unique among the Scombridae in its extremely long and shallow body which reflects externally its many segmented vertebral column. The Xiphiiformes, on the other hand, have a pseudo-dolichosomy which is brought about by the long sword alone, for they have the fewest number of vertebrae of any species in the order (with the exception of *Luvarus imperalus*).

2.—In quality of body form *Acanthocybium* is one of the Scombridae and is quite unlike the Xiphiiformes.

3.—Comparison of the skulls of *Acanthocybium*, *Istiophorus*, and *Xiphias* shows that the specializations seen in the Xiphiiformes are the result of altered stresses developing with the evolution of the sword.

4.—However, the sword may just as easily have arisen from the primitive *Scomber* as from *Acanthocybium*, for both have equally pronounced premaxillae.

5.—A common scombroid heritage is indicated by the general similarity of neurocrania in the three genera studied.

6.—The quality of the vertebral column as a whole is very different in all three genera (Tables II, III, IV).

7.—The individual vertebrae of the three types are so very different in form that it is evident that one is dealing with three divergent lines of scombroid evolution.

It is concluded, therefore, that the wahoo, *Acanthocybium solandri*, is an aberrant but true member of the Scombridae with no genetic relation or even parallelism to the Xiphiiformes. If descendants of an *Acanthocybium*-like ancestor are to be sought perhaps they may be found among the primitive cutlass-fishes, such as *Ruvettus*, which are characterized by many segmented columns.

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TWO NEW FISHES FROM LAKE VICTORIA

By J. T. Nichols and F. R. LaMonte

In a small collection of fishes from Lake Victoria, Africa, which Mr. Michael Lerner had collected and sent to The American Museum of Natural History in 1937, we find the following two fishes which appear to be undescribed.

Micralestes lerneri, new species

Description of Type.—Number 13736, American Museum of Natural History; from Lake Victoria—Michael Lerner Collection, 1937.

Presumably a male; 61 mm. long to base of caudal; depth in this length, 3.5; head, 3.6. Eye in head, 3; snout, 3.5; interorbital, 3.2; greatest width (at back of head), 2; depth of peduncle, 2.9; its length (from anal axil), 2.1; longest dorsal ray, 1.2; longest anal ray, 2; caudal sharply forked, lower lobe (slightly the longer), 1.2; pectoral, 1.2; ventral, 1.5.

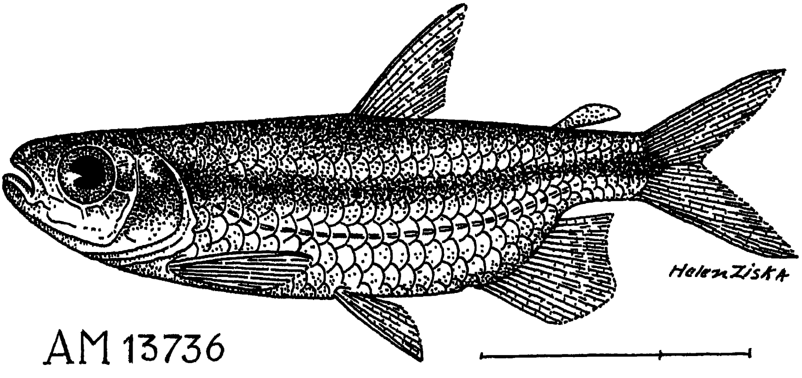

Fig. 1. *Micralestes lerneri*, type.

Dorsal, 10 (8 branched rays); anal, 17 (15 branched rays); scales, 30; gill-rakers about 20 on lower limb of first arch.

Lower jaw somewhat projecting. Maxillary extending nearly to below anterior border of eye. Inner row of teeth of upper jaw compressed, not truncate; a pair of pointed teeth in the middle of the lower jaw behind the main row. Gill-rakers rather long, slender and close-set. Dorsal originating immediately behind vertical from base of ventral, equidistant from base of caudal and front of eye, high and pointed. Pectoral not quite reaching ventral; ventral not reaching vent. Anal broadly rounded. Lateral line complete except for one to three last scales.

Color (in preservative) pale brownish above, whitish below, with a black band from the eye to the middle caudal rays, most intense in a linear oval blotch on the posterior part of the peduncle.

We have also a single paratype, presumably a female, 71 mm. long to base of caudal, differing only slightly from the male except in the following particulars: head, 3.9; length of peduncle, 1.9; front of anal angulated; black lateral band less well marked except peduncular blotch. Dorsal rays, 10 (8 branched); anal, 19 (17 branched); scales, 32.

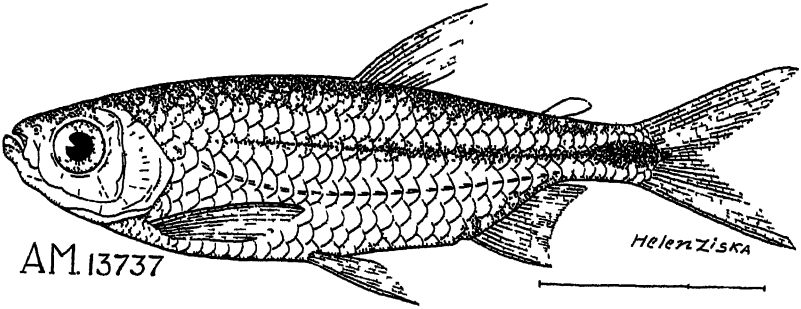

Fig. 2. *M. lerneri*, paratype.

This species resembles *Micralestes humilis* Boulenger, from the Congo, with less numerous gill-rakers; and the widely distributed *Micralestes acutidens* (Peters), with dorsal origin above ventral base, and other slight differences, and has been compared with specimens of both of these.

Tilapia labriforma, new species

DESCRIPTION OF TYPE.—Number 13738, American Museum of Natural History; from Lake Victoria—Michael Lerner Collection, 1937.

Length to base of caudal, 62 mm.; depth in this length, 3.1; head, 3.2. Eye in head, 3.5; snout, 3.5; interorbital, 3.5; maxillary, 3.5; greatest width of body, 2; depth of peduncle, 3; its length, 1.8; longest dorsal spine, 2.2; longest dorsal ray, 1.5; longest anal spine, 2.3; longest anal ray, 1.6; caudal (to tip of lobes), 1.5; pectoral, 1.2; ventral, 1.3.

Dorsal, XV, 9; anal, III, 8; scales, 31; lateral lines, $\frac{21}{11}$. Gill-rakers rather short, pointed, 12 on lower limb of first arch.

Mouth small, lower jaw slightly included, maxillary not reaching to under front of eye. Teeth very small in two rows, the outer bicuspid, on premaxillary and mandible; a single row of minute teeth on maxillary. Scales (under binocular) with distinctly denticulate edges. About three series of scales on cheek, the scaly part about 3/5 the diameter of the eye; and the preorbital about 1/2. Pectoral with a filamentous tip, reaching past front of anal. Corners of the caudal exserted so that the posterior margin of the fin is lunate.

Color (in preservative) uniform, pale, practically without markings except for a dark blotch on the corner of the opercle.

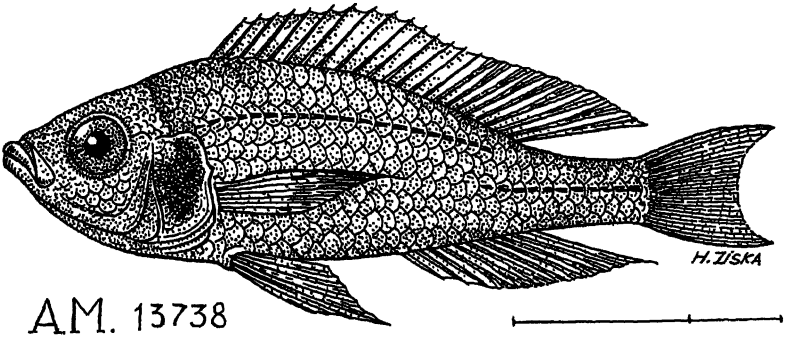

Fig. 3. *Tilapia labriforma*, type.

This species resembles *Tilapia inornata* from Lake Nyassa and is presumably a Lake Victoria representative of this group of the genus. It has a smaller eye than *T. inornata;* fewer scales, with lateral lines overlapping on one scale only; fewer dorsal rays, etc.

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TAXONOMIC STUDIES ON EPHEMERIDA, I: DESCRIPTION OF NEW NORTH AMERICAN SPECIES

BY HERMAN T. SPIETH[1]

Through the kindness of the Natural History Survey of Oklahoma the author received for study an interesting collection of Ephemerida. There was included in the material a new species of the genus *Ephemera* which he takes great pleasure in naming in honor of Dr. Jay Traver. In addition there are described in this paper two other new species of North American mayflies which have been collected from various localities as well as critical notes on the taxonomy of *Iron pleuralis* and *I. longimanus*.

Siphloplecton costalense, new species

Figure 3

IMAGO (dried) ♂.—Eyes blackish; head fuscous except distal half of clypeofrontal area, posterior edge of genae, the three ocelli and the antennal sclerites, all of which are light buff. Thorax fuscous except for four light areas as follows: (1) an area on the mesoscutellum; (2) a band which extends ventrally from the anterolateral corners of the mesonotum, meeting at the mid-ventral line and including the prothoracic coxae; (3) a band which extends ventrally from the bases of the mesothoracic wings and also meets at the mid ventral line, and includes the mesothoracic coxae; (4) a similar band on the metathorax. All trochanters fuscous; all femora fuscous except for a light area medially and another one distally. Fore tibia dilute fuscous; meso- and metathoracic tibia fuscous in basal half and translucent buff distally. Tarsal joints of fore legs dilute fuscous with slightly darker joinings; tarsal joints of meso- and metathoracic legs translucent buff with darker joinings.

Longitudinal veins of fore wing fuscous; the MA from the junction of the Rs to fork and the CU_1 most of its entire length darker than other longitudinal veins. Cross veins of anterior two-thirds of disk and costal region margined and pigmented with fuscous black. Other cross veins fuscous but lacking margination. Small fuscous black clouds between the R_1 and R_2 in the stigmal area and at the forking of the MA. The wing membrane of the anal area posterior to CU_2 is fuscous black. Hind wing with a fuscous black cloud extending diagonally from base of wing to middle of costal area. Venation pigmented similarly to that of fore wing except that distal cross veins are transparent.

First abdominal segment wholly fuscous; segments 2–6 semi-transparent with the following markings: (1) purplish ganglionic spots; (2) fuscous infuscations which

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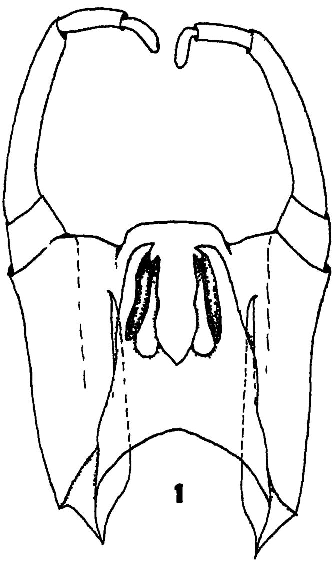
[1] College of The City of New York.



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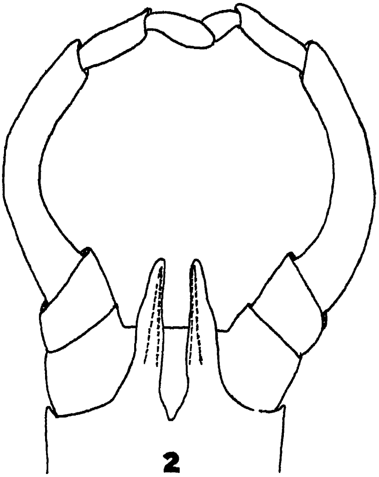

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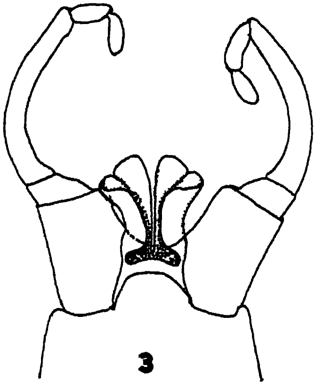

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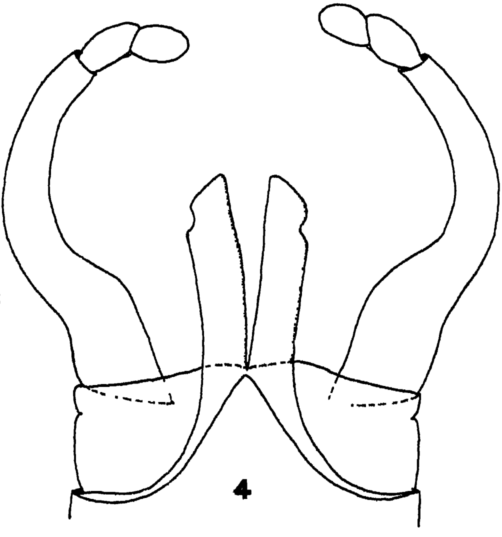

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Fig. 1. Dorsal view of the genitalia of *Parameletus columbiae* McD.
Fig. 2. Dorsal view of the genitalia of *Ephemera traveri*, new species.
Fig. 3. Dorsal view of the genitalia of *Siphloplecton costalense*, new species.
Fig. 4. Dorsal view of the genitalia of *Choroterpes fusca*, new species.

extend anteriorly from base of tergites along medial and lateral areas; (3) two submedial fuscous spots on each tergite. Sternites 7 and 8 opaque, light ochraceous except that the medial part of 8 is clouded with fuscous and that both have dark ganglionic spots. Sternite 9 wholly fuscous except for light lateral areas. Tergites 7 and 8 fuscous except for light-colored posteriorly directed triangular areas which are based laterally on anterior margins of tergites. Tergite 9 wholly fuscous except for a bare indication of a similar light triangular area. Segment 10 fuscous except for sides which are wholly light cream colored. Genital apparatus (Fig. 3) wholly fuscous; caudal cerci translucent pale fuscous with darker opaque joinings. Length 11 mm., fore wing 11.5 mm., hind wing 5 mm.

Imago (dried) ♀.—Similar to male in maculation except that the fuscous black clouds which are found at the bases of the male's wings are completely lacking. In all other respects, except the usual differences between the sexes, similar to the male. Length 13 mm., fore wing 14 mm., hind wing 6 mm.

Variations.—As is usual for the Ephemerida when a large series of individuals of any species from a given locality is considered, there is some variation in the color pattern. Some paratypes are darker than the holotype due not only to deeper intensities of the dark colors but also to the tendency of the dark areas to encroach upon the light ones. There are other paratypes where the reverse is true. The holotype was selected because it seemed to be average insofar as coloration is concerned.

Holotype.—♂, Courtland, Va., April 17, 1935 (H. T. Spieth), in Amer. Mus. Nat. Hist. Coll.

Allotype.—♀, Courtland, Va., April 17, 1935 (H. T. Spieth), in Amer. Mus Nat. Hist. Coll.

Paratypes.—76 ♂, Courtland, Va., April 17, 1935 (H. T. Spieth), 10 in Amer. Mus. Nat. Hist. Coll.; 2 in Cornell Univ. Coll.; 2 in Mus. of Zool., Univ. of Mich. Coll.; 62 in author's collection.

This species is closely related to *S. interlineatum* Walsh but differs from it in having a greater expanse of light areas on the thorax and also in having dark maculation on the posterior sternites. The genitalia differ from those of *S. basale* Walker in that the penes, while lacking spines, are broadest distally.

The distribution of *S. costalense* is interesting. Its nearest relative, *S. interlineatum*, lives in the upper Mississippi River drainage. Traver has reported *S. signatum* from North Carolina and *S. speciosum* from Georgia, both of which are quite distinct and easily differentiated from *S. costalense*. *S. basale*, the best-known species of the genus, is northern in distribution but ranges into the southern highlands. Thus *S. costalense* is geographically separated from its nearest relative by more remotely related species. Such a type of distribution is fairly common in other groups, but so far as can be determined this is the first time it has been reported in the Ephemerida.

In connection with the other species of *Siphloplecton*, it seems worth noting that nymphs of *S. basale* collected at Lakehurst, N. J., show a mixed population of which a large percent are atypical for the species, especially in that they lack the three longitudinal dark stripes on the abdominal sternites, retaining only the medial stripe. A small percentage, however, are quite typical. The adults from Lakehurst, although differing somewhat from the typical *S. basale,* nevertheless clearly belong to that species. Further collecting will probably show that two geographical subspecies meet in the Lakehurst region. It should therefore be observed that that part of the key to nymphs in "The Biology of Mayflies" by Needham and Traver which deals with *S. basale* is useful only when typical specimens are available.

Choroterpes fusca, new species

Figure 4

IMAGO (dried) ♂.—Head piceous; basal joints of antennae fuscous; flagellum lighter. Prothorax and synthorax shining fuscous black except for some pleural sutures and the coxae which are fuscous. Legs except coxae translucent gray, becoming progressively lighter distally except for meso- and metathoracic tarsi which are slightly darker. A blackish mark submedianly on femur and likewise at the femoral-tibial articulation. Fore wing membrane hyaline except for the costal and subcostal areas proximal to the humeral cross veins which are tinged with fuscous. Costal, subcostal and radial veins tinged with fuscous; other longitudinal veins as well as the cross veins hyaline; cross veins practically invisible. The coloration of the hind wings is similar to that of fore wings.

Abdominal tergites fuscous over all except for the following lighter colored areas: (1) a discontinuous mid-dorsal light line on segments 2–8, widest on 3 and 4; (2) submedial oval spots on segments 2–7; (3) ventral and lateral to these submedial areas on segments 2–8 are roughly triangular areas based on the anterior margins of the tergites. Abdominal sternites 1–7 translucent gray; 8th sternite cream colored with black traces on its anterior and posterior margins; 9th sternite and basal forceps joint fuscous; remainder of forceps cream colored; caudal cerci pale cream color with faintly darkened joints. The genitalia (Fig. 4) are intermediate in structure to those of *C. basalis* and *C. terratoma.* Length 6.5 mm., wing 6.5 mm.

VARIATIONS.—Some of the male paratypes differ from the holotype by having the synthorax and abdomen slightly lighter in coloration.

IMAGO (dried) ♀.—Except for the usual sexual differences and a general lighter coloration, the females are similar to the males. Length 5.5 mm., wing 6.5 mm.

HOLOTYPE.—♂, Algoma, Ontario, September 1, 1934 (H. T. Spieth), in Amer. Mus. Nat. Hist. Coll.

ALLOTYPE.—♀, Algoma, Ontario, September 1, 1934 (H. T. Spieth), in Amer. Mus. Nat. Hist. Coll.

PARATYPES.—10 ♂ and 7 ♀, Algoma, Ontario, September 1, 1934 (H. T. Spieth), 2 in Amer. Mus. Nat. Hist. Coll.; 2 in Mus. of Zool., Univ. of Mich. Coll.; 13 in author's collection. I also have two specimens of the same species from Redding, Conn., July 21, 1933.

This species is close to *C. albiannulata* from which it can be readily distinguished by the darker abdominal maculation. The lighter color of the fore leg, especially the fore femur, is also a distinguishing feature.

The entire Algoma series was collected about three o'clock in the afternoon while they were engaged in nuptial flight over a small stream. In common with their relatives of the genus *Paraleptophlebia,* the nuptial flight was comparatively close to the surface of the water, in this case about 4 to 12 feet above the stream. Apparently their small size and relatively great transparency protect them from their arch enemies, the insectivorous birds.

Parameletus columbiae McDunnough

Figure 1

McDunnough, 1938, Can. Ent., LXX, pp. 31–32, Fig. 1.

Imago (dried) ♂.—Head fuscous; thorax generally fuscous, a piceous transverse band between fore legs; the tips of the meso- and metascutella tipped with piceous; legs uniformly fuscous with fore coxa, trochanter, femur and tibia being slightly darker than the corresponding parts of the meso- and metathoracic legs. Wings with all neuration bister brown; in fore wings the cross veins of costal and subcostal areas proximal to bulla weak but distinct; distal to bulla, cross veins of costal area are strongly anastomosed; wing membrane wholly hyaline. Tergites of abdomen uniformly bister brown except for a slightly lighter coloration in anterolateral corners. Lateral edges of tergites 8 and 9 light buff. Sternites 1–8 bister brown with lighter anterolateral areas which tend to spread across sternites and fuse. Sternite 9 with bister medial area and fuscous lateral areas. In addition a pair of small lateral fuscous spots on sternites 1–8. Forceps base bister brown with anterolateral corners lighter; distally the forceps base (Fig. 1) is excavated on each side, leaving a central hump; forceps fuscous; penes dark fuscous; cerci uniformly light bister. Length 11 mm.; fore wing 11 mm.

While this paper was in press, McDunnough (Can. Ent., LXX, pp. 31–32, Fig. 1) described this species from material collected at Dunn Peak, North Thompson River, B. C. On July 7, 1936, I collected six specimens at Fishing Bridge on Yellowstone Lake, Wyo., which unquestionably belong to *P. columbiae.* Since McDunnough's material all came from a single locality and differs in a few small details from the Yellowstone material, I have published my description in full so as to give other workers a further knowledge of the amount of variation that is to be found within this species.

Ephemera traveri, new species

Figure 2

Imago (in alcohol) ♂.—General coloration bister brown. Head fuscous with pale antennae; pronotum fuscous except for a pale central area and light lateral areas; meso- and metanota light bister brown; pleural sclerites colored like metanota but with sutural areas much lighter; thoracic sternites bister brown; all coxae similar to metanota in color; trochanter, femur and tibia of fore leg translucent light buffy brown; fore tarsal joints almost colorless; fore tarsal claws light brown; meso- and metathoracic legs, except for coxae, similar to fore tarsi in color. Longitudinal veins of fore wing translucent bister brown; cross veins piceous; anterior half of humeral cross vein between costal border and subcosta colorless while remainder of this vein and all cross veins proximal to bulla broadly infuscated; distal to bulla the entire costal and subcostal membranes are infuscated. A brown fascia extending from bulla to IMP with the part between MA_2 and IMP offset distally from main body and considerably fainter; a brown cloud also between MP_1 and MP_2 at proximal end; cross veins of disk lightly infuscated. Venation of hind wings similar in color to that of fore wings except posterior longitudinal veins are lighter. Distal part of hind wing membrane broadly infuscated. Abdomen dorsally an intense bister brown with the following lighter areas: (1) a slender, discontinuous medial line; (2) just lateral to the medial line on each side are light streaks based on the anterior margins of each segment and posteriorly diverging laterally. On segments 8 and 9 these streaks fuse with the light median line and thus enclose a pair of slender dark patches; (3) segment 10 almost wholly light. Sternites translucent light bister brown, a pair of lateral, discontinuous longitudinal dark stripes which are slightly dilated anteriorly. Basal joint of forceps light bister; remainder of genitalia light. Penes (Fig. 2) slender tapering rods quite different from those of any other known North American species. Cerci light with dark joining. Length 11 mm.; wing 12 mm.

IMAGO (in alcohol) ♀.—The color pattern of the female is similar to that of the male except that it is lighter over all with a tendency for the light areas, especially those of the abdomen and thorax, to encroach on the dark areas. The wings are clearer than those of the male and there is a sharper demarcation between light and dark areas. Length 14 mm.; wing 12 mm.

VARIATIONS.—As is usual with members of this genus, there is considerable variation between individuals in coloration, some showing a tendency toward a reduction in intensity and spread of the bister ground color, which is especially apparent in the wings and the abdomen.

HOLOTYPE.—♂, Flint, Okla., June 19, 1937 (Standish and Kaiser Coll.), in Amer. Mus. Nat. Hist. Coll.

ALLOTYPE.—♀, Flint, Okla., June 6, 1937 (collector unknown), in Amer. Mus. Nat. Hist. Coll.

PARATYPES.—117: 1 ♂, Flint, Okla., June 19, 1937, in Amer. Mus. Nat. Hist. Coll.; 4 ♂ and 9 ♀, Flint, Okla., June 8, 1934, in Amer. Mus. Nat. Hist. Coll.; 4 ♂ and 9 ♀, Flint, Okla., June 8, 1934, in Okla. A. and M. Coll.; 2 ♂ and 9 ♀, Flint, Okla., June 8, 1934, in author's collection; 2 ♂ and 6 ♀, Flint, Okla., June 6, 1934, in Amer. Mus. Nat. Hist. Coll.; 1 ♂ and 69 ♀, Flint, Okla., June 6, 1934, in Okla. A. and M. Coll.; 1 ♂, Flint, Okla., June 6, 1934, in author's collection.

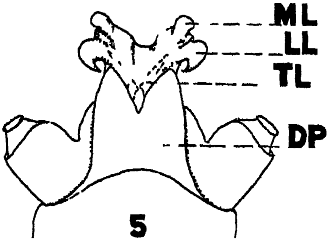
E. traveri can be distinguished from its close relative *E. simulans* Walker by the generally lighter coloration, the distinctive genitalia, the lack of a cloud in the apical part of the radial sector of the fore wing and by the presence of the subdorsal light areas of the abdomen on segments 2–9.

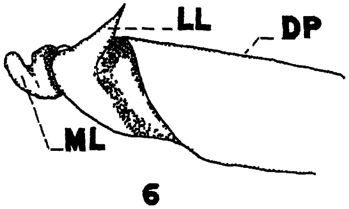
It is to be noted that the holotype apparently was allowed to desiccate before being placed in alcohol. Consequently the abdominal color pattern is not as clear cut as in some of the paratypes. Unfortunately most of the paratypes are in rather poor condition.

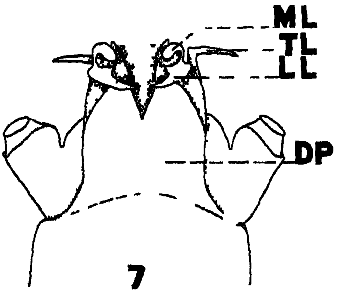
Iron pleuralis Banks

Figures 5 to 8

Banks (1910, Can. Ent., XLII, p. 202) described a new species which he named *Heptagenia* (*Epeorus*) *pleuralis*. Accompanying the brief description was a rather inadequate drawing of the male genitalia. His type material was collected near Gloversville, New York, by Alexander, on May 15, no year given. Ulmer (1920, Stett. Ent. Zeit., LXXXI, [H.II] p. 142) synonymized this species with *Iron longimanus* Eaton. Later workers did not follow Ulmer's synonymy but did accept his placement of the species in the genus *Iron* as correct.







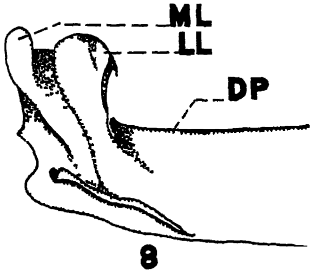


Fig. 5. Dorsal view of the normal penes of *Iron pleuralis* Banks.
Fig. 6. Lateral view of the normal penes of *Iron pleuralis* Banks.
Fig. 7. Dorsal view of the expanded penes of *Iron pleuralis* Banks.
Fig. 8. Lateral view of the expanded penes of *Iron pleuralis* Banks.

Explanation of abbreviations: DP, dorsal plate; TL, titillators; LL, lateral lobes; ML, median lobes.

A few years ago, Traver studied the type material and found that the penes of the genitalia do not agree with the forms which are commonly accepted as being typical for *pleuralis.* Utilizing an original paratype of Banks, she redescribed the species (1935, "Biology of Mayflies," pp. 407–408, Fig. 106). The material which had been previously known under the name *pleuralis,* and which she now considered to be without a valid name, was designated by the new name *I. fraudator* (idem, p. 402, Fig. 105). In discussing *fraudator* and *pleuralis,* Traver says of the former: "This species is so similar in general appearance to *I. pleuralis* that we are unable to find any character other than genitalic structure by which to distinguish it. Further, the two species occur together; specimens of both have been taken in the same swarm." My own observations bear out these statements. Invariably, however, in any nuptial swarm *I. pleuralis* is much rarer than *I. fraudator.* For instance, of 72 specimens taken in a nuptial swarm at Blairstown, N. J., only 2 belonged to *I. pleuralis.* Other collections from various localities present the same picture.

That two populations should be able to retain their identity when they are so alike in their ecology and behavior, not to mention their structural similarities, seems doubtful. Accordingly I have thought it worth while to study the single difference that Traver has utilized to separate these two populations: i.e., the penes of the genitalia.

The penes (Fig. 5) of the so-called *I. fraudator* are fused along the median edges so that, instead of the paired structures usually found in the Ephemerida, there is a single more or less tubular structure. As seen from above, the penes terminate distally in two large laterally directed processes, each of which is secondarily divided into two lobes. The most lateral of these ends in a sharp spine, which curves around until it is directed medioanteriorly. This (Fig. 5 LL) I have called the lateral lobe. The median lobe (Fig. 5 ML) ends bluntly and extends posterolaterally. Ventrally (Fig. 5 TL) there is a pair of slender, sharply bent titillators. The dorsal surface of the body of the penes is formed by a heavily scleritized, posteriorly bifid plate (Fig. 5 DP) which I have named the dorsal plate. Viewed laterally (Fig. 6) it can be seen that the tips of the lateral lobes, in addition to being directed anteromedially, are also directed dorsally. The medial lobes, however, extend posteriorly.

On first glance (Figs. 7 and 8), the penes of the so-called *pleuralis* look much different from those of *fraudator.* Careful investigation shows that there are no differences except those which can be accounted for by assuming that the ventral parts of the penes have been expanded ventrally and laterally while the dorsal part (i.e., the dorsal plate) has remained stationary. Thus, with the distal end of the dorsal plate acting as a pivot (Figs. 7 and 8), the dorsal lobes have been forced dorsally and medially, while the medial lobes have been forced only dorsally. The titillators have been carried posteriorly and laterally so that they now extend laterally. The dorsal plate is completely unaffected by these movements except that the edges are extended due to the lateral expansion of the penes, which makes the dorsal plate appear somewhat wider. Thus the only known difference between *I. pleuralis* and *I. fraudator* disappears and it is consequently necessary to consider *I. fraudator* as a synonym of *I. pleuralis*. It should be noted that the drawings have been made from two individuals collected at the same time during the nuptial flight. All comparable drawings have been made to identical scales.

In the eastern part of the United States, *Iron pleuralis* is the first member of the genus to emerge in the spring. Near New York City, the adults are first seen during the early part of May and are then relatively common until the first of June. In the cooler streams such as are found in the higher elevations of the Catskill and Ramapo mountains, the emergence continues into the middle of June. Ide, in a splendid paper (1935, Univ. of Toronto Studies, Biol. Series No. 39) dealing with the effect of temperature upon the mayflies of the Nottawasaga River and its tributaries, has discussed *I. pleuralis* in detail. He shows, among other things, that a long emergence period at any given locality is definitely associated with a low average temperature of the stream throughout the year. Field observations that I have made on *I. pleuralis* are in no way at variance with Ide's findings. It is evident that this species cannot tolerate high stream temperatures and is consequently lacking from the streams of the New Jersey coastal plain and from many other small lowland streams near New York City.

In this connection, it is interesting to note that in the vicinity of Bloomington, Ind., which is farther south and where the average stream temperatures are fairly high, *I. pleuralis* is able to maintain itself only in the cold clear streams that issue from some of the limestone caves so numerous in this region. During the warm summer months when many of these cave streams almost dry up, no young nymphs of *I. pleuralis* are to be found. Apparently, as Ide suggested, the newly laid eggs of this species remain in a dormant state for a period of time and hatch later in the fall when the temperatures are lower. The young nymphs develop rapidly and by the following May emerge as adults. The most apparent explanation of how *I. pleuralis* could have reached these cave streams is to assume that at some previous period, perhaps during the last glaciation, stream temperatures in general were much lower in this region so that the species was able to spread throughout the area. With the warming up of the streams, they have all been eliminated except those that retreated to the small cool streams that flow from the caves. The only other feasible explanation is that *I. pleuralis* has gradually evolved from a form which lives in the streams but in a different ecological niche, i.e., lower in the stream and consequently in a region of higher average temperature. Such an explanation does not seem reasonable in view of the fact that no other species of the genus *Iron* lives in these streams. Thus it would be further necessary to assume that after the parent stock gave rise to *I. pleuralis,* it became extinct. This appears unlikely. It therefore seems highly probable that *I. pleuralis* represents a glacial relic in the region of southern Indiana.[1]

Iron longimanus Eaton

The clearing up of the relationship of *I. fraudator* Traver to *I. pleuralis* Banks immediately raises another problem. There exists a western species by the name of *I. longimanus* Eaton which is a close relative of the true *I. pleuralis* Banks. In "The Biology of Mayflies" (p. 408), Traver described a new species, *I. proprius*. Only four badly faded specimens preserved in alcohol were available. They are very similar to *I. longimanus* in all respects except for the genitalia. The latter are almost identical with those possessed by the individuals which Traver considers to be typical of *I. pleuralis*. Thus *I. proprius* Traver bears the same relation to *I. longimanus* Eaton that the so-called *I. fraudator* Traver bears to Traver's concept of *I. pleuralis* Banks. An inspection of several hundred specimens of *Iron* which I collected at various localities in Colorado and Wyoming yielded a few *I. proprius* while the remainder were undoubtedly *I. longimanus*. A careful study of the genitalia of *I. proprius* shows clearly that the penes are identical with those of *I. longimanus* Eaton except that they are in an expanded condition. Structurally, ecologically and numerically *I. proprius* and *I. longimanus* parallel *I. fraudator* and *I. pleuralis*. Consequently *I. proprius* must be considered a synonym of *I. longimanus*.

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[1] While this paper was in press McDunnough (Can. Ent., LXX, pp. 23–35) published a paper in which he deals with the validity of *Iron fraudator* Traver and *Iron pleuralis* Banks. In addition to these two species, he also considers *I. confusus* Traver. His conclusions concerning Traver's definition of *I. pleuralis* are identical with mine, i.e., that the apparent difference in the penes as shown by Traver is due to distortion and that in their normal position they are of the typical *longimanus* type. McDunnough had available for study a large series of the true *pleuralis* from Canada, New England and upper New York State as well as paratypes of *I. confusus* Traver and *I. fraudator* Traver. From a study of these he concludes: "I would retain the name *pleuralis* Banks with synonym *confusus* Traver for our Canadian species, leaving *fraudator* as very doubtfully distinct for the present and applied to the larger, darker form from more southerly regions." It happens that the large series I had available for the present paper are from "more southerly regions," i.e., New Jersey and southern New York.

Before discussing these specimens it should be noted that (1) the original colors of the true *pleuralis* Banks will probably never be known since the type specimens were preserved in alcohol and during the years since 1910 have doubtlessly faded; (2) *Iron fraudator* and *I. confusus* differ only in that the thorax and abdomen of *confusus* are light red-brown, while the thorax and abdomen of *fraudator* Traver are dark red-brown. Likewise the venation of the former species is light brown while that of the latter is dark brown. Unfortunately Traver ("Biol. of Mayflies," pp. 398 and 402) made no attempt to keep the two original descriptions comparable in construction, and details that are carefully given for one species are completely omitted in the other description. Thus *confusus* Traver has "tails light yellow-brown, very indistinctly darker at joinings," while *fraudator* has "tails dark brown" but there is absolutely no mention of the *presence* or *absence* of joinings. Such a procedure applies not only to the above-mentioned species but to practically all closely related species discussed by Traver, which reduces the value of her work immeasurably.

In addition to the color differences, McDunnough states that *fraudator* is larger than *pleuralis*. Traver definitely says that the minimum and maximum wing lengths and the minimum body lengths of both species are exactly the same. The only size difference given is in maximum body lengths, where *fraudator* might be 0.5 mm. longer. In this connection it is interesting that Ide (Univ. of Toronto Studies, Biol. Series No. 39, pp. 37–38) clearly shows that in the case of *Iron pleuralis* "the first full-grown nymphs of the season are large, and as the season advances the full-grown nymphs are smaller and reach a minimum size at the height of the emergence and then increase in size towards the end of the season." If the nymphs vary in size there seems no reason to believe that the resultant adults should not also vary in size.

Returning to a consideration of the series from New Jersey and southern New York, it is important to note that while some specimens are as large as those that Traver had for her original descriptions, most of them are smaller. A great many of the individuals are "dark red-brown" in general coloration and thus fit the qualifications of *I. fraudator*, but in every mating swarm there are others which are much lighter and represent typical specimens of *I. confusus* as well as intermediates between the two extremes. The Heptageniidae are notorious for the amount of color variation between individuals of the same species, and members of the genus *Iron* seem not to be exceptions. Thus I feel that the only differences between *confusus* Traver and *fraudator* Traver are individual rather than specific and that both should be considered synonyms of *Iron pleuralis* Banks.

Why should the penes of some individuals of these two species be "expanded?" At present no adequate answer is available. Perhaps it is the result of convulsive movements that accompany death. Another possibility is that it is a movement of the penes that normally occurs at copulation. It is of interest to note that a specimen of *I. longimanus* from Rocky Mountain National Park shows an intermediate condition between the normal and the "expanded" state.

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TAXONOMIC STUDIES ON THE HYDRAS OF NORTH AMERICA. V[1]

DESCRIPTION OF *HYDRA CAULICULATA*, N.SP., WITH NOTES ON OTHER SPECIES, ESPECIALLY *HYDRA LITTORALIS*

BY LIBBIE H. HYMAN

DESCRIPTION OF *HYDRA CAULICULATA*, NEW SPECIES

GENERAL CHARACTERS.—This hydra greatly resembles in general appearance *Hydra carnea* L. Agassiz, 1850, previously described (Hyman, 1931*a*), and was at first thought to belong to this species or at best to constitute a variety of *carnea*. Further study, however, and the eventual finding of sexual forms have led me to consider it a separate species. *Hydra cauliculata* (Fig. 1) is of moderate size, of medium brown color, and with tentacles longer than the column, mostly 1 1/2 to 2 times the column length. Its distinctive characteristic, which differentiates it from other American species assigned to the genus *Hydra*, is the slender stalk. As pointed out in the first paper of this series (Hyman, 1929) in all hydras the column is divisible into the thicker distal stomach or body region in which food is digested, and the more slender pale proximal region, the stalk, extending from the budding zone to the pedal disk. This stalk region differs histologically from the other body regions of hydra, having very clear vacuolated entoderm cells and lacking entodermal gland cells. In some hydras, which were separated by Schulze (1917) into the genus *Pelmatohydra*, the pale slender stalk contrasts markedly with the stout dark brown stomach region. Schulze left in the genus *Hydra* (strict sense) only those species in which the distinction between stomach region and stalk is not very noticeable. The present species lies between the two extremes and should possibly be allocated to the genus *Pelmatohydra*; but its affinities in other respects with species of *Hydra* have led me to place it in that genus. In *Hydra cauliculata*, then, the stalk is noticeably more slender than the stomach region (whence the specific name, from the Greek *kaulos*, a stalk) so that well-fed specimens of this species often resemble *Pelmatohydra oligactis* (the common brown hydra) except for their smaller size and lighter coloration. The tentacles are usually six in number and take on the attitudes characteristic of long-tentacled hydras (see Hyman, 1930). They arise unevenly on buds as is usually the case in long-tentacled species but no definite order of appearance of the tentacles on buds has been noticed.

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[1] See bibliography at end of this article for references to Nos. I to IV, inclusive, of this series.

NEMATOCYSTS.—The nematocysts of this species unfortunately offer nothing distinctive and are scarcely to be distinguished from those of *Hydra carnea.* They are of a type characteristic of a number of species of hydras. In referring to nematocysts I shall hereafter adopt the terminology of Weill (1934) whose extensive studies on coelenterate nematocysts have enabled him to invent a logical system of nomenclature for these bodies. In Weill's terminology, the large barbed nematocysts of hydras, called penetrants by German writers, are renamed STENOTELES; the small rounded type which emits a coiled thread, the volvent of the Germans, is called a DESMONEME; and the intermediate sorts with a simple long tube ("thread") are termed ISORHIZAS, in place of the German name glutinants. There are two kinds of glutinants in hydras, a larger sort with a spiny tube, and a smaller sort with a smooth tube. These become holotrichous and atrichous isorhizas, respectively, in Weill's system. In *Hydra cauliculata,* the stenoteles are relatively small, ranging from 9 to 14 μ, most being about 12 μ along the longest diameter. The holotrichous isorhizas (Fig. 2, *c, d*) are of the elongated oval shape characteristic of most hydras with about three transverse or diagonal coils of the tube near the end of discharge. They are 8–10 μ in length. The small or atrichous isorhizas (Fig. 2, *b*) and the desmonemes (Fig. 2, *a*) are of about the same length, 5–6 μ. The chief difference from *H. carnea* is that in *H. cauliculata* the desmonemes are as long as or longer than the small isorhizas while in *carnea* they are smaller.

SEX ORGANS.—In order to differentiate the present species with certainty from *H. carnea,* it was highly desirable to secure sexual specimens. Repeated attempts to induce sexuality by alteration of temperature were finally successful. The species differs from *carnea* in that it is dioecious; but both testes and embryonic theca resemble those of *carnea.* The testes (Fig. 3) are larger and more plump than those of *carnea,* but are of the mammiform type common to a number of species of hydra. The embryonic theca (Fig. 4, *a, b*) is spherical and covered with flat-topped spines as in *carnea* but the spines are somewhat longer. The entire embryonic theca was found to have a diameter of 0.43 mm. and the spines were 0.045 mm. long. Unfortunately no measurements were

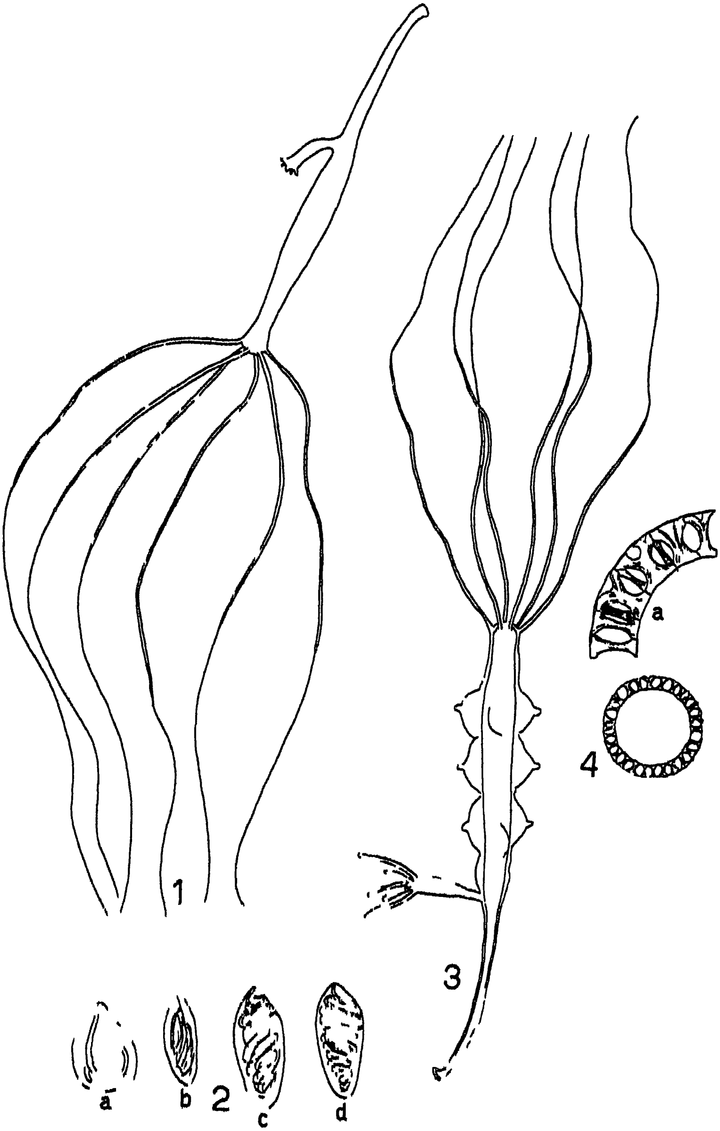

Fig. 1. *Hydra cauliculata*, n.sp., from life.

Fig. 2. Nematocysts of *Hydra cauliculata*, from life. *a*, desmoneme; *b*, atrichous isorhiza; *c*, *d*, holotrichous isorhizas.

Fig. 3. Male of *Hydra cauliculata*, from life.

Fig. 4. Developing egg of *H. cauliculata*, showing the spiny theca. *a*, a small part of the theca, enlarged.

made of the spines of the theca of *H. carnea* but the present figure 4 *a* may be compared with figure 13 in my 1931 publication. The shape of testes and the shape and length of the spines of the embryonic theca leave no doubt that *H. cauliculata* is distinct from other American species, although closely related to *H. carnea.*

Distribution.—The material on which the description is based originated from a few specimens which were brought to me by Dr. C. E. Hadley who collected them in a stream-fed pond near Montclair, New Jersey. Successful cultures were reared from the original specimens and were kept under observation for some time. It is my opinion that hydras previously received from a lake at Gainesville, Florida, through the courtesy of Mr. R. P. Trogdon, were also of the species under consideration. These Florida specimens were also made the basis of successful cultures and were maintained for many months, but in the end I was not sure that a mixture had not occurred between the New Jersey and Florida cultures. Because of this possibility, it has seemed best to base the description on the New Jersey material and to consider Montclair, New Jersey, to be the type locality. It is probable that *Hydra cauliculata* is common in the Atlantic coast states; but it is not identical with the unnamed hydra mentioned by Papenfuss (1934) from the vicinity of Baltimore. Miss Papenfuss' species is undoubtedly, as she remarks, distinct from any of the described American species of hydra; but further data are needed before her species can be adequately defined.

Type Specimen: Cat. No. 1970, American Museum of Natural History.

Summary.—*Hydra cauliculata,* a new species from Montclair, New Jersey, has the following distinguishing characteristics: moderate size, tentacles 1 1/2 to 2 times the column length; desmonemes smaller than the small isorhizas; dioecious; testes mammiform, plump; embryonic theca spherical with spines of moderate length. The last four characters differentiate *H. cauliculata* from its nearest relative, *H. carnea,* in which the desmonemes are as long as the small isorhizas and which is hermaphroditic with lower testes and shorter thecal spines.

FURTHER NOTES ON *HYDRA LITTORALIS* HYMAN, 1931

I am fortunately able to complete the description of this, the most interesting endemic American hydra, and to furnish new data on its distribution. The finding of this species in several new swift-water habitats has confirmed my surmise that this species lives only in moving water. *Hydra littoralis* was originally found in company with a typical swift-water fauna in great abundance on the under surface of stones in the Yacht Harbor in Jackson Park, Chicago, at a place where the harbor exits into Lake Michigan and which is subject to constant wave action, often quite vigorous. The same species was later found in another part of the lagoon in the same park in a site subject to a considerable water current. From these findings, together with my failure to cultivate the form successfully in the laboratory, I concluded that the species must be confined to moving water, unlike most hydras, which are characteristic of still or relatively quiet waters.

I have now to record the taking of *Hydra littoralis* in two swift-water localities near New York City, in both cases under stones in spillways from lakes. In the spring of 1935 I was informed of the occurrence of hydras on the under side of stones in a spillway from Grassy Sprain reservoir, an artificially made lake near Yonkers, N. Y. The information came from members of the City College of New York and I was taken to the site through the courtesy of Mr. Louis Robinson, then a student at this institution. From the reservoir, formed by the damming of a stream, an artificially constructed spillway descends in steps and finally joins a spring-fed stream. Some of the stones cemented into the bottom of the artificial channel have come loose and on their under sides hydras live in fair abundance subject to a strong current when the reservoir is full. As in the Chicago habitat, the hydras here were living in company with typical swift-water animals, mostly insect larvae. The hydras were carefully examined and found to be identical with the Chicago specimens of *Hydra littoralis.* Unlike the latter, however, they were easily cultivated in the laboratory, especially if algae or other green plants were present in the culture.

Recently, in March, 1937, Mr. Robinson brought me typical specimens of *Hydra littoralis* which he had collected under stones in a spillway at Pompton Lake, New Jersey. These were also cultivated and sexual specimens very soon appeared in the cultures from which I was at last able to secure fertilized eggs, hitherto unknown.

Hydra littoralis has also been found under stones in a creek near Norman, Oklahoma, associated with a swift-stream fauna (Trowbridge, Bragg, and Self, 1936), on March 17, 1936. Young males as well as budding individuals were noted.

The finding of the species in such widely separated localities as Oklahoma, Chicago, and New York indicates that *H. littoralis* is widespread throughout the United States in a variety of swift-water habitats, such

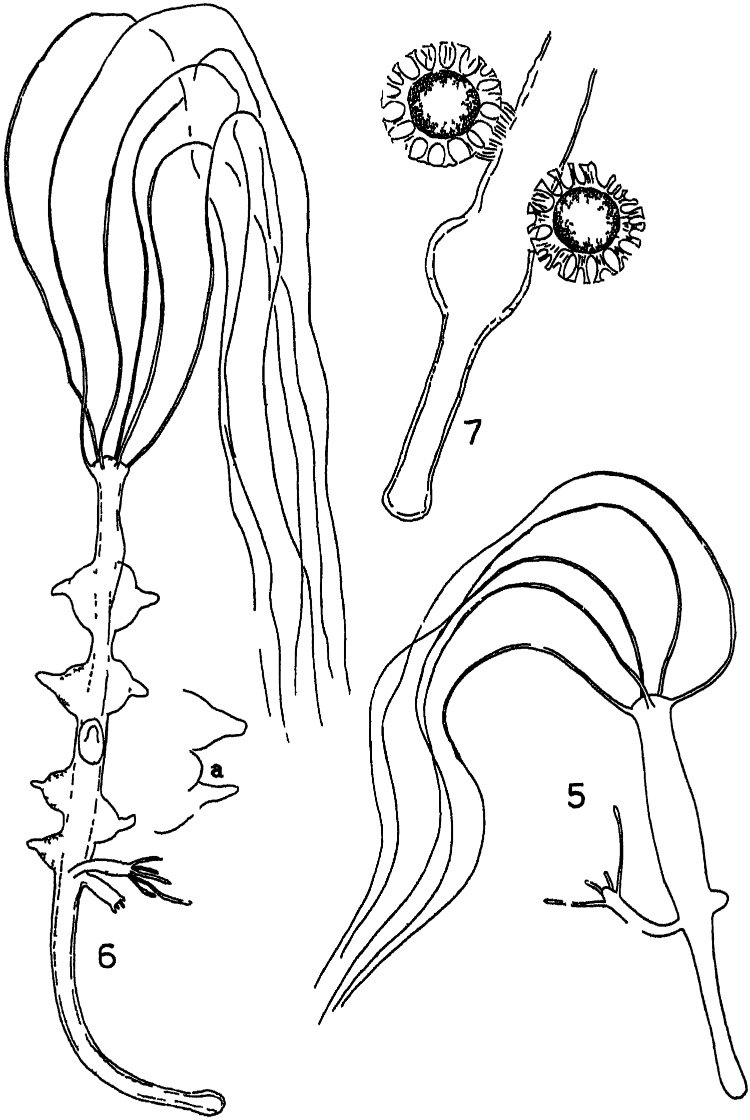

Fig. 5. *Hydra littoralis* Hyman, 1931. Laboratory culture, showing full extent of tentacles.

Fig. 6. *Hydra littoralis*, from life, old male, with maximum development of testes. *a*, some other shapes of testes.

Fig. 7. *Hydra littoralis*. Female, basal region only, showing two developing eggs each with a long-spined theca, whole mount.

as ordinary swift streams, spillways, and shores subject to wave action. It is hoped that zoölogists will be on the lookout for the species in such types of habitat in other localities.

As already mentioned I was able to cultivate New York specimens successfully and can therefore now complete the description of the species. Under cultivation the species loses the unusual green, orange, and pink tints which it displays in nature and becomes of the ordinary medium brown color common to hydras. The natural colors therefore probably result from the type of food available in the habitat. The kinds of animals suitable for food (probably insect larvae) would undoubtedly be different in the swift-water habitats where *H. littoralis* lives than in the pond habitats characteristic of most hydras.

The full spread of the tentacles was seen whenever the laboratory cultures were in good condition and is shown in figure 5, drawn from life. The tentacles attain a length of about 1 1/2 times that of the column and take on the attitudes characteristic of long-tentacled species.

In Chicago, male specimens were found in nature in the late fall, and consequently it was concluded that sexuality is induced in this species as in most other hydras by a falling temperature. Trowbridge, Bragg, and Self (1936), however, found young males in March, and the culture which I started from specimens brought to me from Pompton Lake in March soon became sexual. Later this same culture on being returned to room temperature after a short exposure to low temperature (5 °C) again displayed sexual activity. It therefore appears that in *Hydra littoralis* sexuality is induced by either a falling or a rising temperature and there must be two sexual periods annually in nature.

Fully-developed males and females were seen in the Pompton Lake culture. A mature male is shown in figure 6. It is evident that the males previously depicted (Hyman, 1931*b*) were not at the maximum of testes development. The testes start out as long low ridges which eventually break up into separate testes. When fully mature these testes are high and plump with very long and stout nipples, differing from those of other hydras in their size. Figure 6 gives the typical appearance of an old male from life and figure 6 *a* shows some other variations in testis form.

Although, as is usual among hydras, the males far outnumbered the females in the culture, some females fortunately appeared, some days after testis formation was initiated, and at last I had the good luck to see the fertilized eggs of this species. Each female produced only two or three eggs, generally one at a time, occasionally two simultaneously. A female with two embryos each inclosed in its theca is drawn in figure 7, from a mounted slide. The theca is spherical with very long spines, similar to those of *Hydra americana* (Hyman, 1929). The spines are often somewhat scanty in number. Measurements of several thecae gave the following figures: diameter of entire theca, 0.45 to 0.55 mm., majority 0.45 to 0.50 mm.; length of spines on typical thecae, 0.08 to 0.12 mm. One or two eggs were observed with short spines, 0.06 to 0.07 mm. long, but there was evidence that these eggs had been disturbed during the process of formation of the theca.

McConnell (1935) has recently maintained that the form of the embryonic theca is not a reliable taxonomic character because it is subject to alteration under altered environmental conditions. His contention does not carry conviction because the conditions of his experiments are not clearly stated. An atypical spination of the thecae was observed after transfer of hydras to foul or low oxygen water but it is not stated at what stage of egg production the transfer occurred. Any disturbance of a hydra after the ripe egg has been extruded results in malformation of the theca. Further, hydras will not live in foul or low oxygen water and hence in nature there would be no thecae formed under such conditions. I have found the shape and spination (or lack of spination) of the embryonic theca reasonably constant for each species. In the case of every species which I have described and of which I have figured the theca, at least several embryos with thecae were seen and in some species many thecae have been available for observation. In the case of the two species here under consideration, *H. cauliculata* and *littoralis*, about a dozen thecae of each have been seen.

There are now known in the United States four species of *Hydra* with spherical spiny thecae. With regard to length of the spines, these species fall into the following order, arranged from shortest to longest spines: *carnea, cauliculata, americana, littoralis. Pelmatohydra oligactis* and *pseudoligactis* and *Hydra canadensis* Rowan, 1930, have a spineless spherical theca and *H. utahensis* is characterized by the spineless helmet-shaped theca.

DISTRIBUTIONAL NOTES ON OTHER SPECIES

Hydra americana Hyman, 1929 (white hydra).—This very well-defined species has been personally identified in collections from the following localities: Princeton, New Jersey, courtesy Professor Ulric Dahlgren; Montclair, New Jersey, courtesy of Dr. C. E. Hadley; Van Cortlandt Park, New York City, courtesy of Mr. Joseph Silberstein; and

Mt. Desert Island, Maine. Bragg (1937) has recently recorded finding the species near Norman, Oklahoma. These records indicate that this species, previously officially recorded only from around Chicago, is widespread throughout the United States.

Pelmatohydra oligactis (Pallas), 1766 (brown hydra).—This species has been personally identified in collections from: Rochester, New York, courtesy Dr. Mary Rawles; Van Cortlandt Park, New York City, courtesy Mr. Joseph Silberstein; and Montclair, New Jersey, courtesy of Dr. C. E. Hadley. Miller (1936) found it common in Douglas Lake, Michigan.

Pelmatohydra pseudoligactis Hyman, 1931 (false brown hydra).—Miller (1936) records this species from Douglas Lake, Michigan. So far this hydra has been taken only in the midwestern states. As it can be distinguished from *P. oligactis* only by microscopic examination of the nematocysts (or finding of males), it has probably been frequently misidentified as *oligactis* in the past, and consequently some of the older records of *oligactis* may really have concerned *pseudoligactis*.

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NORTH AMERICAN RHABDOCOELA AND ALLOEOCOELA. II[1]

REDISCOVERY OF *HYDROLIMAX GRISEA* HALDEMAN

By Libbie H. Hyman

In the spring of 1935, Professor Dahlgren of Princeton University requested me to attempt the identification of an unusual and interesting turbellarian which he had noticed appearing in abundance every spring in fresh-water habitats in the vicinity of Princeton. After examining the beautifully prepared serial sections sent me by Professor Dahlgren I reported that the animal was an alloeocoel of the family Plagiostomidae and that I believed it to be new and to merit the creation of a new genus. Later through the kindness of Professor Dahlgren I saw the animal alive in its natural habitat. We found many large red-brown capsules similar to those of planarians plastered to the under surface of the stones frequented by the animal. These were shown to be the capsules of the plagiostomid as they hatched in a couple of weeks into small worms resembling the parent forms in all respects. The life-cycle of the animal then appears to be as follows. The sexually mature plagiostomids come to the shallower parts of their habitats in the spring to lay their egg capsules and then die. The young hatching from these capsules return to the normal habitat, the muddy bottoms of old slow streams. By the following spring they have grown to sexual maturity and again seek the shores for breeding purposes.

While looking through some old papers on American Turbellaria, I accidentally discovered that this plagiostomid had been seen before and that in fact it was at one time very abundant in old streams in eastern Pennsylvania and New Jersey. The species was discovered by Haldeman in 1842 and named by him *Hydrolimax grisea.* Haldeman apparently thought the animal was some sort of slug. He described correctly the color pattern and the positions of the mouth and the genital pore, mistaking the latter for a mucous pore. Later and independently, Leidy (1851), from whose sharp eyes no fresh-water invertebrate seems to have escaped, found the animal in abundance in the Delaware and

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[1] The first paper of this series of articles was published in 1936, in Trans. Amer. Micro. Soc., LV, pp. 14–20, under the title: 'Studies on the Rhabdocoela of North America.'

Schuylkill rivers and being unaware of Haldeman's description, renamed it *Cathesia stellato-maculata.* The specific name refers to the stellate pigment spots. Girard, in his résumé of North American planarians (1893), called attention to the identity of Leidy's and Haldeman's species and gave some recognizable figures of *Hydrolimax grisea.* I have been unable to find any mention of the animal since Girard's publication and apparently the species has disappeared from most of its former habitats because of pollution of the water.

The family Plagiostomidae is a well-known family of small alloecocoelous Turbellaria, chiefly marine, comprising a considerable number of species, most of which fall into the genus *Plagiostomum.* Of the few known fresh-water plagiostomids, *Plagiostomum lemani,* from central European lakes, especially the Swiss lakes, is the commonest and has received the most attention. *Hydrolimax grisea* is the first fresh-water plagiostomid to be found in North America; some other fresh-water alloeocoels are, however, known for this continent, such as prorhynchids and *Bothrioplana.* The more important references on the anatomy and systematics of the Plagiostomidae are: Böhmig (1890), Hofsten (1907), Graff (1911, 1913), Bock (1923), and Brandtner (1934). *Hydrolimax* adds another genus to the previously recognized genera of the family: *Plagiostomum* O. Schmidt, 1852; *Alvaera* Bock, 1923 (= Hallezia Graff, 1908); and *Brachyposthia* Brandtner, 1934.

Hydrolimax grisea Haldeman

Hydrolimax grisea HALDEMAN, 1842, Proc. Acad. Nat. Sci. Phila., I, p. 166.
Cathesia stellato-maculata LEIDY, 1851, Acad. Nat. Sci. Phila., V, p. 289.
Hydrolimax griseus HALDEMAN, GIRARD, 1893, Ann. Sci. Natur., (7) XV, p. 161.

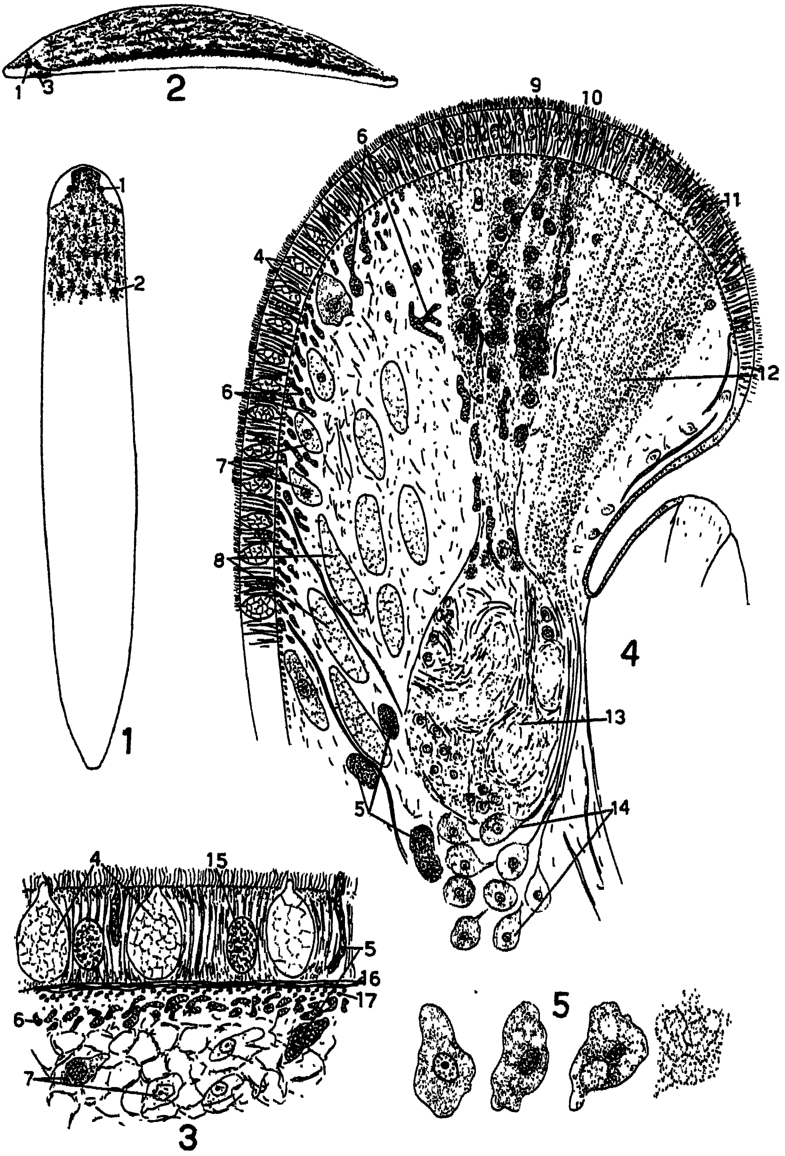
The following account is confined to the anatomy and histology of *Hydrolimax* as Professor Dahlgren will write a separate account of the general habits, breeding and egg-laying, ovogenesis and early development, matters which have proved exceptionally interesting. The abundance of this species in the spring at Princeton has furnished an unusual opportunity to make a thorough study of a representative of a group ordinarily found only in small numbers.

1. EXTERNAL CHARACTERS.—*H. grisea* is an unusually large alloeocoel, attaining a length of 13–15 mm., although the majority of mature specimens are somewhat smaller than this. The body is soft, slimy, and plump, flattened below, highly rounded above, tapering to a rounded anterior end, and a more pointed posterior end (Figs. 1 and 2). The color is dark gray above, seen to consist on magnification of oval

dark pigment-spots connected with each other by spidery pigment-lines. At the anterior end the color narrows suddenly and extends to the anterior end only between the eyes. The lower surface is white and the white color at the anterior end continues onto the dorsal surface as a crescentic white area to either side of the median dark band. The boundary between white and gray is very sharp and gives the anterior end an unmistakable appearance with its gray center and white sides (Figs. 1 and 2). At the boundary of the gray and white areas on the head are seen the eyes, a pair of black ovals so deeply set as to be inconspicuous. They were missed by Haldeman but seen by Leidy and Girard. The general appearance is that of a miniature gray slug but the type of locomotion is not sluglike. The animal progresses rapidly in the smooth gliding manner characteristic of the smaller Turbellaria, caused by ciliary action. Owing to its plump, cylindroid shape, it rolls from side to side as it moves and is easily turned over.

The conspicuous mouth is located on the ventral side of the head (Fig. 2) and the common genital pore is found near the posterior extremity on the ventral surface (Fig. 14).

2. Epidermis.—The body is clothed in a columnar epithelium, here called epidermis. It is ciliated throughout and appears to be syncytial, as noted for various alloeocoels by other observers; at least it is impossible to find any definite cell walls in the best available sections. The free border consists of the basal bodies of the cilia (Fig. 3). The epithelium itself seems to be composed of parallel strands extending from the free border to the basement membrane (Figs. 3, 4). A similar structure has been described for the epidermis of other plagiostomids by Böhmig, Hofsten, Brandtner, etc. Between these strands are elongated clear spaces called vacuoles by German workers. They have no definite walls in *Hydrolimax* and appear to be simply transparent ground substance in which the strands are imbedded. At intervals throughout the epidermis are seen the large nuclei whose size precludes the possibility that the strands could represent the walls of very narrow cells. The epidermis contains numerous large oval bodies which discharge through the surface (Figs. 3, 4). These bodies, termed "wasserklaren Räumen" by Böhmig, are in my sections of *Hydrolimax* obviously containers of a mucous secretion which forms a network in the interior. These slime reservoirs, as I shall call them, do not seem to be cells. German workers have failed to find any parenchymal gland cells with which they are connected, but I believe that in *Hydrolimax* they are related to certain large cells seen in the parenchyma adjacent to the epidermis (Figs. 3, 4).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My reason for so thinking is that near the dorsal epidermis of the anterior end, where the slime reservoirs are particularly abundant, there occur in the adjacent parenchyma very large bodies having the same appearance as the reservoirs (Fig. 4). Transitional stages can be found between these bodies and the large cells just mentioned. It thus seems probable to me that the large cells alter and enlarge into slime bodies (Fig. 5) and these discharge by means of the slime reservoirs. In addition to the slime reservoirs the epidermis is perforated by the outlets of cyanophilous gland cells located in the parenchyma. These are coarsely granular cells which stain a deep blue in Mallory's triple stain. Rhabdites appear to be absent in *Hydrolimax.*

The epidermis is slightly taller at the two body extremities than elsewhere. At the anterior tip just above the mouth this taller epidermis is punctured by the numerous outlets of the frontal glands (see below) as shown in figure 4. Just dorsal to this region is a zone of sensory epidermis connected with the brain by a conspicuous ganglionated tract containing many ganglion cells (Fig. 4). This sensory epidermis does not differ as far as could be determined on the available sections from the epidermis elsewhere but it must be assumed that it contains sensory endings of some sort. The sensory epidermis, like the general epidermis, is filled with slime reservoirs which are here much smaller than elsewhere. Posterior to the sensory region, the epidermis contains a great abundance of slime reservoirs which stain more deeply than elsewhere and so are particularly conspicuous. It is in this region above the brain that one can find most easily transitional stages between the large parenchymal cells mentioned above and slime bodies (Fig. 5). First vacuoles

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Fig. 1. Dorsal view of *Hydrolimax grisea* from life. Pigmentation is shown for only a small area.

Fig. 2 Side view of *Hydrolimax grisea* from life.

Fig. 3. Small portion of a section to show structure of epidermis and adjacent parts.

Fig. 4. Sagittal section of the anterior end.

Fig. 5. Different appearances of large sub-epidermal cells believed to represent stages in the transformation of such cells into mucous-containing networks.

1, eye; *2*, pigment spots; *3*, mouth; *4*, slime reservoir; *5*, cyanophilous gland; *6*, pigment bodies; *7*, large sub-epidermal cells; *8*, mucous stages of the same; *9*, sensory area at tip of head; *10*, ganglionated tract to same; *11*, exits of frontal glands; *12*, bundle of ducts of frontal glands; *13*, brain; *14*, cluster of frontal gland cells; *15*, nucleus of epidermis; *16*, circular sub-epidermal muscle layer; *17*, longitudinal sub-epidermal muscle layer.

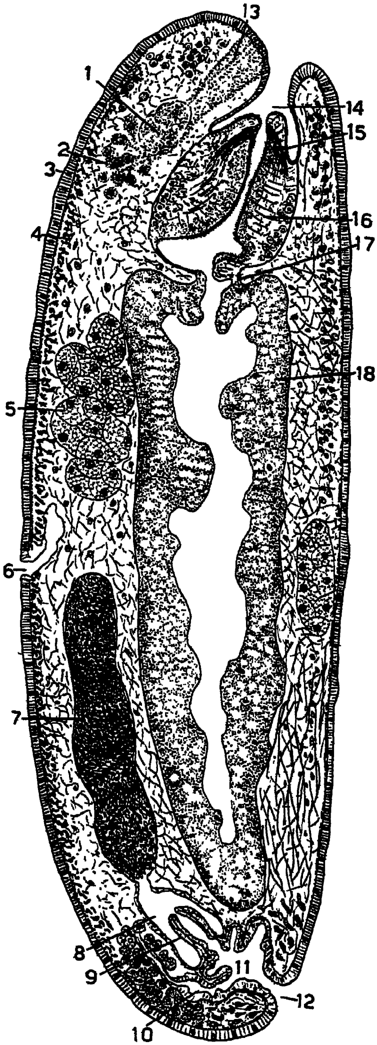
appear in the large cells, their nuclei become condensed and shrunken, and eventually the entire cell is converted into a vacuolated mass with ill-defined contours, without a nucleus, and staining like mucous (Mallory's triple stain). Several cells seem to fuse together to form one of these large mucous masses. Indications of a connection of the mucous masses with the slime reservoirs have been seen. Stages shown in figure 5 can be found everywhere beneath the epidermis, but they are less numerous than in the parenchyma dorsal to the brain. The evidence indicates that the slime reservoirs are the outlets of parenchymal slime bodies which in turn represent transformed parenchymal cells.

The epidermis of *Hydrolimax* is evidently adapted for secreting large amounts of slime on short notice through its slime reservoirs. These apparently substitute for rhabdites.

At the posterior end around the genital pore the epidermis is perforated by the exits of the numerous caudal glands, eosinophilous glands located in the adjacent parenchyma. They take a brilliant pink stain in eosin or acid fuchsin and are probably concerned in egg-laying, presumably secreting the cement by which the capsules are attached to objects. They also are generally supposed to function as a holdfast during locomotion.

3. SUB-EPIDERMAL STRUCTURES AND PARENCHYMA.—Beneath the basement membrane of the epidermis is found the usual sub-epidermal muscle sheath characteristic of the Turbellaria. In *Hydrolimax* it consists of two very thin strata, an outer circular and an inner longitudinal layer (Fig. 3). Internal to the muscle sheath are seen on the dorsal side the pigment bodies, small masses of various shapes filled with black spherules. Whether these are cells could not be determined. Pigment bodies also occur in the interior along the large sensory tract extending from the anterior epidermis to the brain (Fig. 4).

All interior space not occupied by the digestive tract and the reproductive system is filled with parenchyma. The parenchyma of *Hydrolimax* conforms to Böhmig's account of that of other plagiostomids, consisting of alveoli of a firm homogeneous substance inclosing a more fluid, faintly granular material (Fig. 6). Nuclei are present here and there in the angles of the network. Besides the structures already described, such as the pigment bodies and the cells and masses related to the slime reservoirs, the parenchyma contains a few muscle fibers, mostly longitudinal, and several sorts of gland cells. The gland cells of the Turbellaria, according to the analysis of German specialists, consist of two main types, eosinophilous and cyanophilous. The former stain with eosin or



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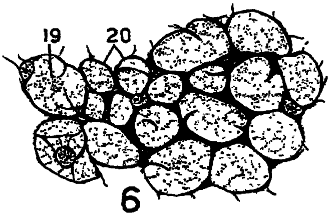

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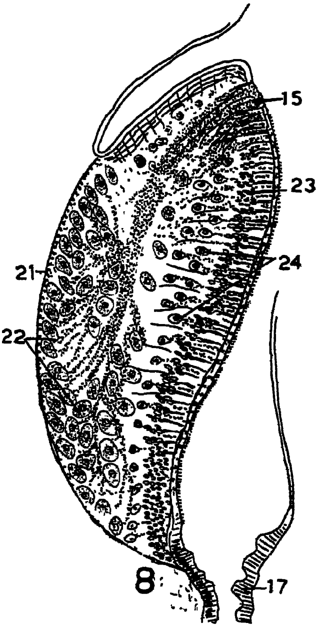

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Fig. 6. Parenchyma of *Hydrolimax grisea.*

Fig. 7. Sagittal section of *Hydrolimax grisea.*

Fig. 8 Sagittal section of the pharynx, only dorsal half shown.

1, brain; *2*, frontal glands; *3*, epidermis; *4*, pigment layer; *5*, yolk glands; *6*, mid-dorsal excretory pore; *7*, granule vesicle; *8*, penis bulb; *9*, penis; *10*, common oviduct with attendant gland cells; *11*, common genital atrium; *12*, genital pore; *13*, bundle of ducts of frontal glands; *14*, pharyngeal cavity; *15*, bundle of gland ducts in pharynx; *16*, pharynx; *17*, esophagus; *18*, intestinal sac; *19*, granular substance inclosed in parenchymal mesh; *20*, walls of mesh; *21*, muscular septum; *22*, large type of gland cell; *23*, circular muscles; *24*, small type of gland cell.

fuchsin; the latter take on a blue color in Mallory's triple stain and hence are presumably of a mucous nature. The gland cells are typically pyriform cells filled with fine or coarse granules or rodlike inclusions; they are situated in the parenchyma and have long necks which act as ducts and discharge through an epithelium onto a free surface. Apparently in Turbellaria epithelial cells themselves never become gland cells. The caudal glands around the genital pore furnish an example of eosinophilous gland in *Hydrolimax.* Of the cyanophilous type there occur the scattered sub-epidermal cyanophilous glands which discharge through the epidermis (Fig. 3) and the frontal glands (Fig. 4). The latter form a cluster immediately behind the brain whose very long stalks run forward beneath the brain as a bundle perforating the epidermis just above the mouth opening (Fig. 7). At this place the epidermis is permeated with the exits of these glands stuffed with secretion granules. The frontal glands are of wide occurrence throughout the Turbellaria but their function is unknown. Their exits are commonly associated with a sensory epithelium as is also the case in *Hydrolimax* and hence their secretion must be of some importance, probably with regard to the capture or the swallowing of prey.

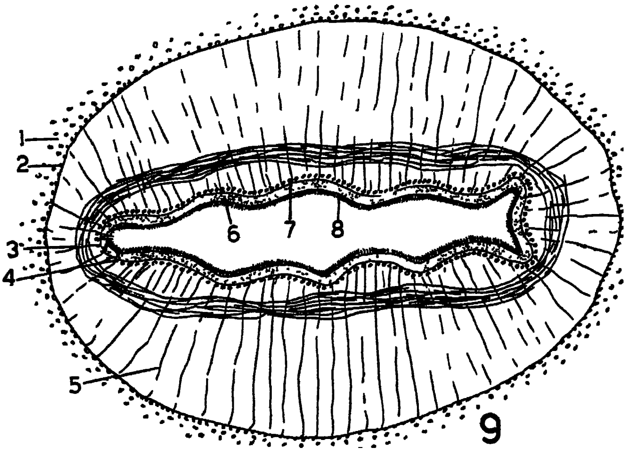
Other numerous glands of the parenchyma are associated with the reproductive system and will be described in that connection.

4. DIGESTIVE TRACT.—A sagittal view of the digestive tract is given in figure 7. The ventral mouth leads into the small pharyngeal cavity into which projects the anterior end of the pharynx. The remainder of the conspicuous musculo-glandular pharynx is imbedded in the parenchyma and leads by a narrowed channel into the elongated blind sac of the intestine. This type of digestive tract is of course characteristic of the turbellarian orders Rhabdocoela and Alloeocoela in part.

At the entrance to the pharyngeal cavity the epidermis quickly diminishes in height, and cavity and pharynx are lined by a thin homogeneous layer in which no cell walls or nuclei can be discerned. This lining is not an "eingesenkt" epithelium, such as has been found in many Turbellaria, with nuclei sunk into the parenchyma. No nuclei can be seen in the adjacent parenchyma. The lining of the pharyngeal cavity appears to lack cilia but that of the pharynx lumen is clothed with short cilia.

The pharynx is of the bulbose type common to the Rhabdocoela and some Alloeocoela. That of the Plagiostomidae falls into the category called pharynx bulbosus variabilis by von Graff, found only in Alloeocoela. The chief distinguishing feature of the pharynx variabilis is, according to von Graff, the inversion of the muscle layers of the periphery as compared to those next the lumen. It now appears, however, that this inversion is not present in all alloeocoels with a bulbose pharynx and in fact species of the same genus may vary in this respect. For this reason Steinböck (1923) proposed the subdivision of the pharynx variabilis into two types, intextus without the muscle layer inversion, and textus with such inversion. The pharynx of *Hydrolimax* is of the variabilis intextus type; but it is a question whether there are any real grounds for distinguishing the bulbose pharynx of alloeocoels from the doliiform pharynx of many rhabdocoels.

The pharynx of *Hydrolimax* is a compact dorso-ventrally flattened body oriented nearly parallel to the body surfaces (Fig. 7) and sharply separated from the general parenchyma by a muscular septum. The interior is filled with muscle fibers and gland cells imbedded in a scanty amount of parenchyma (Fig. 8). The lumen, as already noted, is lined by a ciliated layer devoid of cell walls or nuclei. Next this occurs a very thin stratum of longitudinal muscle fibers followed at a little distance by a thick zone of circular fibers, best seen in figure 9. No definite sphincter of circular fibers near the anterior end of the pharynx, such as has been described for other plagiostomids, was found in *Hydrolimax*. Internal to the circular layer, the pharynx is filled with gland cells, of which two sorts have been noticed, a small type near the circular muscles and a larger and more numerous type filling the peripheral half of the pharynx. The smaller kind discharge directly into the lumen along the whole length of the pharynx and their ducts filled with secretion granules can be seen passing between the muscle fibers. Some of the larger gland cells discharge in a similar way but the ducts of the majority join into a conspicuous bundle which runs forward and then curves medially to discharge *en masse* near the anterior tip of the pharynx (Figs. 7 and 8). This bundle of gland ducts is a notable feature of the *Hydrolimax* pharynx and in cross section is seen to form a circular zone in the anterior free part of the pharynx. The lining membrane of the pharynx lumen appears to be absent where the bundle of ducts discharges. The outer surface of the pharynx consists of a muscular septum in which the inner fibers are circular, the outer longitudinal. Surrounding the pharynx there is a zone of longitudinal fibers in the parenchyma, and these evidently are related to pharynx activities. A large number of radial muscle fibers extend from the pharynx lumen to its periphery (Fig. 9). There are no external gland cells attached to the pharynx. The pharyngeal glands are of the cyanophilous type.



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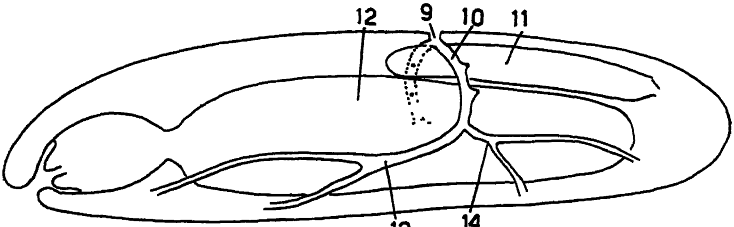

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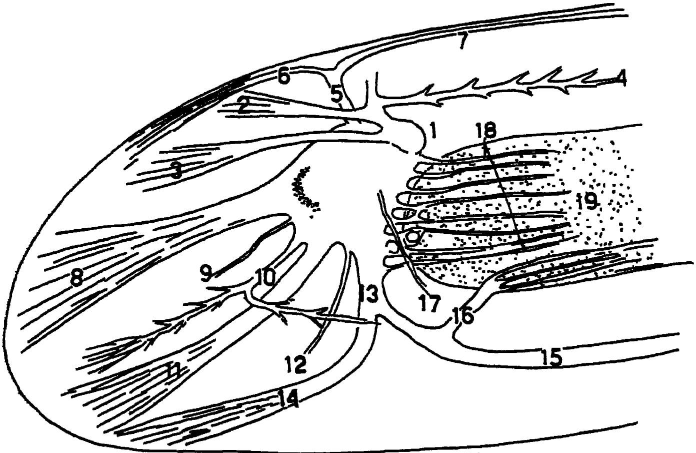

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At its posterior end the pharynx narrows to a short tube usually called esophagus (Figs. 7, 8) and at this region the pharynx lining increases in height and becomes cellular and nucleated (Fig. 8). The muscle layers next the pharynx lumen continue in diminished thickness along the esophagus.

The esophagus leads into the intestine, a simple elongated sac extending posteriorly to the copulatory apparatus. It is lined by a tall wavy epithelium (Fig. 7) which in the majority of the available preparations is syncytial without definite cell walls. A syncytial condition of the intestinal epithelium is reported as characteristic of plagiostomids by several European workers. However, in one set of sections, this epithelium is plainly cellular, composed of tall bulbous cells like those of the intestine of planarians. It therefore seems that either the intestinal epithelium of *Hydrolimax* may alter from a syncytial to a cellular state or else the cell walls commonly break down on fixation. The intestinal epithelium is highly vacuolated with basal nuclei and distal inclusions, presumably digesting food. No gland cells could be found in the epithelium. There appeared to be a few scanty muscle fibers along its outer surface.

5. EXCRETORY SYSTEM.—The main channels of the protonephridial system can be readily noticed in sections of *Hydrolimax*. The course of these vessels bears only a general resemblance to that found by Hofsten for *Plagiostomum lemani*. The chief vessels are depicted diagrammatically in figure 10. There is a main excretory pore in the mid-dorsal line at about the level of the anterior end of the granule vesicle. From this pore

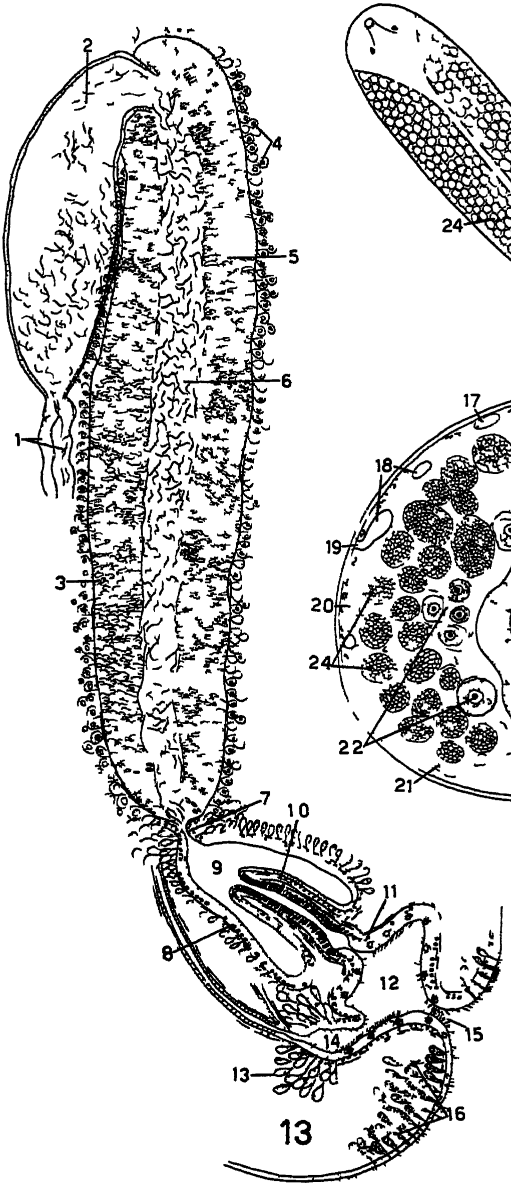
Fig. 9. Cross section through the pharynx of *Hydrolimax grisea*.

Fig. 10. Diagrammatic view of the excretory system from the side.

1, outer longitudinal muscles; *2*, outer circular layer; *3*, inner circular layer; *4*, inner longitudinal layer; *5*, radial muscles; *6*, lining syncytium; *7*, inner longitudinal layer; *8*, cilia; *9*, main mid-dorsal pore; *10*, transverse trunk with accessory pores; *11*, granule vesicle; *12*, intestine; *13*, main anterior branch; *14*, main posterior branch.

Fig. 11. Diagrammatic view of the brain and its nerves.

1, main dorso-lateral ganglion; *2*, *3*, sensory branches from same; *4*, laterodorsal nerve; *5*, main medio-dorsal trunk; *6*, anterior sensory branch of same; *7*, dorsal body nerve; *8*, main sensory trunk to tip of head; *9*, small nerve; *10*, sensory nerve for lateral part of head; *11*, sensory nerve for antero-ventral region of head; *12*, small nerve; *13*, main ventral trunk; *14*, sensory branch of same to ventral region of head behind nerve *11*; *15*, ventro-lateral body nerve; *16*, pharyngeal branch of nerve *15*; *17*, small nerve; *18*, branches into pharynx; *19*, pharynx.



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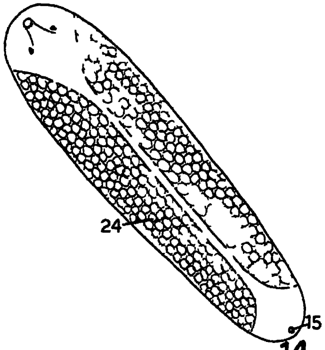

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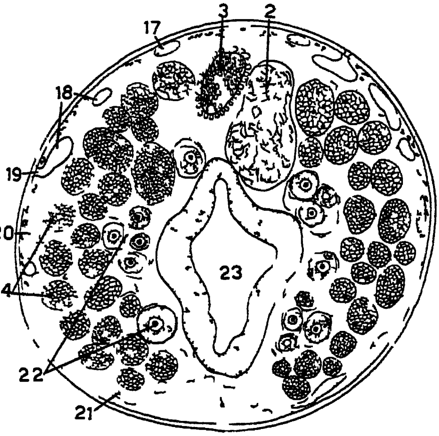

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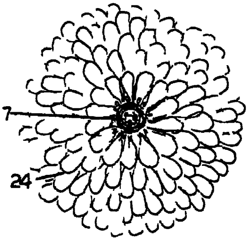

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a large channel descends on either side in the transverse plane close to the epidermis. These transverse channels may have additional apertures to the outside (Fig. 10). In ventro-lateral regions each divides into an anterior and a posterior branch and these again subdivide into dorsal and ventral branches. The smaller channels could not be followed because of the difficulty of distinguishing them with certainty from simple parenchymal spaces but the impression was gained that the main trunks give off many small twigs. All of the larger vessels run close beneath the epidermis.

6. NERVOUS SYSTEM.—The nervous system of *Hydrolimax* is closely similar to that of *Plagiostomum lemani* described by Hofsten. The brain is a prominent bilobed mass situated above the free anterior end of the pharynx (Fig. 7). It gives off anteriorly a number of sensory nerves, some very large and conspicuous, others small and slender, and posteriorly three pairs of nerves, dorsal, lateral, and ventral as in other alloeocoels. Figure 11 depicts schematically the results of study of several sets of serial sections in which the nerves were fairly distinct. The figure makes no claim to completeness; other small nerves may have been present but I believe the main trunks are all indicated. From a dorso-lateral brain mass there springs a large nerve (Fig. 11, *1*) which gives off anteriorly two sensory branches to the dorso-lateral regions of the head (*2*, *3*) and posteriorly the lateral nerve (*4*). From the mediodorsal region of the brain arises a large trunk (*5*) which divides into an anterior sensory branch (*6*) to the mid-dorsal part of the head and a posterior trunk, the dorsal nerve. The anterior tip of the brain near the eye continues into a very massive sensory trunk (*8*) containing many ganglion cells and already mentioned as supplying a sensory area on the

Fig. 12. Cross section through *Hydrolimax grisea* at level of transverse excretory canals.

Fig. 13. Sagittal view of terminal parts of reproductive system.

Fig. 14. Ventral view of *Hydrolimax grisea* to show distribution of yolk glands.

Fig. 15. Cross section of connecting canal with its halo of unicellular glands.

1, vasa deferentia; *2*, seminal vesicle; *3*, granule vesicle; *4*, granule glands; *5*, secretion zone of granule vesicle; *6*, central tract of sperm; *7*, connecting canal; *8*, penis bulb; *9*, cavity of penis bulb or internal seminal vesicle; *10*, penis papilla; *11*, penis sheath; *12*, common genital atrium; *13*, glands around common oviduct; *14*, cavity of common oviduct; *15*, genital pore; *16*, caudal glands; *17*, dorsal nerve; *18*, transverse excretory canal; *19*, a pore of same; *20*, lateral nerve; *21*, ventral nerve; *22*, ovaries; *23*, intestine; *24*, yolk glands; *25*, glands around connecting canal.

anterior tip just above the zone of exit of the frontal glands (Fig. 4). Ventral to this trunk there appeared to be a small nerve (*9*) which may have been part of *8*. Next comes a sensory trunk (*10*) which divides into anterior and posterior branches going to the lateral region of the head. The large sensory nerve *11* with the large branch *14* from trunk *13* completes the sensory supply of the ventral regions of the head. A small trunk *12* could not be traced very well. From the ventral part of the brain springs nerve *13* which gives off an anterior sensory branch *14* and a posterior branch *15* which becomes the ventral body nerve and gives rise near its origin to a pharyngeal branch *16*. The main nerve supply of the pharynx consists, however, of numerous nerves which pass into the pharynx directly from the posterior surface of the brain (*18*). They enter the anterior end of the pharynx and extend in the pharynx tissue near its periphery as parallel strands. These must make a circular zone in the pharynx but I was not able to detect this in cross sections. A definite nerve ring such as has been described for the pharynx of other plagiostomids appears to be absent.

The three main body nerves, *4*, *7*, and *15*, course backward throughout the body length as the lateral, dorsal, and ventral nerves, respectively, and can be seen in these positions in cross sections of the body (Fig. 12). They lie in the peripheral parenchyma near the epidermis and give off many branches.

7. REPRODUCTIVE SYSTEM.—The reproductive system is of paramount importance in the systematics of the Platyhelminthes and hence has received the most attention in my study since my main purpose was to establish the taxonomic position of *Hydrolimax*. The reproductive system closely resembles that of the genus *Plagiostomum*, from which it differs chiefly in the excessive length and size of the granule (or prostate) vesicle. *Hydrolimax* is of course hermaphroditic, but apparently somewhat protandrous.

The testes occur as numerous small follicles situated in the dorsolateral parenchyma opposite the anterior part of the intestine. Their connections with the vasa deferentia were not seen. The vasa deferentia can be observed only in the vicinity of the seminal vesicle where they occur as a pair of ill-defined tubules which open into the rear end of this body (Fig. 13). The seminal vesicle is a large oval structure situated dorsally at about the middle of the animal, generally to one side of the median line. The mid-dorsal region of the posterior half of *Hydrolimax* is occupied by the enormous granule vesicle, a large cylinder which extends from the copulatory apparatus to about the middle of the worm, usually to the level of the main excretory pore. The anterior end of the seminal vesicle curves and joins the anterior end of the granule vesicle. The former is above or to one side of the anterior part of the latter. The seminal vesicle is packed with sperm which also occupy a central tract in the granule vesicle (Fig. 13) encircled by the curious secretion of the latter. This secretion has the form of closely packed ovals and presumably originates from the numerous unicellular granule glands which cover the surface of the granule vesicle (Fig. 13). The wall of both seminal and granule vesicles seems to consist of a structureless membrane.

At its posterior end the granule vesicle narrows to a short connecting canal encircled by numerous unicellular glands which joins it to a chamber called the distal sac by German workers. The latter is a conical chamber containing the penis proper or penis papilla, and in comparison with other Turbellaria would represent an internal seminal vesicle, also called true seminal vesicle, and its inclosing wall would correspond to the penis bulb. It is true this wall is less muscular than the typical penis bulb but I see no reason for inventing a new term and consequently shall call this chamber the penis bulb. It obviously must assist in the erection of the penis as is the function of the penis bulb in general among the Turbellaria. The penis papilla is a moderately elongated structure which projects into the internal seminal vesicle, that is, away from the genital pore; it obviously must turn inside out when used in copulation. This inverted position of the resting penis is common throughout the genus *Plagiostomum*. Beyond the penis bulb is another chamber, the common genital atrium, into which the penis base projects as a structure termed the penis sheath by German workers. The common genital atrium is an expanded chamber which receives in its postero-dorsal wall the common oviduct and which exits below by the common genital pore.

The histological structure of these parts is difficult to make out satisfactorily in the available preparations. The connecting canal appears to be lined by a syncytial epithelium. It is provided with obvious and well-developed muscle layers, an inner circular and an outer longitudinal and is encircled as already noted by a dense halo of large unicellular glands different from those of other parts of the male apparatus (Fig. 15). The penis bulb (distal sac of German workers) has a similar structure and is also provided with glands but these are small and of a different sort. The outer surface of the resting penis (which would be the lining layer when in use) is similar in structure to the wall of the penis bulb; but its interior (which would become the exterior at copulation) differs somewhat histologically. Its lining is reduced to a mere membrane next to which is found a very thick layer of circular muscle fibers. The common genital atrium has the same structure as the general body wall, being lined by a ciliated syncytial epithelium underlain by circular and then longitudinal muscle fibers. No gland cells are attached to the atrium.

The spermatozoa are of the type characteristic of the Plagiostomidae, with a central long filamentous nucleus and winglike lateral protoplasmic expansions.

The female system is simple, consisting of ovaries, oviducts, and yolk glands without any accessory sperm-receiving chamber. The ovaries occur to either side of the gut (Fig. 12) extending forward to the pharynx. They can hardly be spoken of as a pair of definite bodies, for each consists of a number of masses which seem to have no connection with each other except presumably by way of the oviduct. The ovaries are therefore follicular like the testes. Each mass or follicle consists of a fibrous parenchyma in which there are imbedded several ova in various degrees of development. Professor Dahlgren has made a special study of ovogenesis and finds that each ovum is surrounded by a non-cellular halo presumably of nutritive nature and is attended by a cell of some size which he calls the accessory cell. I have not found a similar description for the ovaries of any other plagiostomids. The very numerous and conspicuous yolk glands occupy nearly the whole of the peripheral half of the lateral body regions from pharynx to copulatory apparatus (Figs. 12, 14). Their distribution from a ventral view is shown in Fig. 14. They are also follicular, consisting of little rounded masses each composed of several cells filled with numerous darkly staining inclusions, contained in a reticulate cytoplasm. There is an oviduct on each side running between the mass of ovarian follicles on its inner side and the mass of vitellarian follicles on its outer side. It is a ciliated tube which gives off a ciliated branch to each follicle. At the posterior end the two oviducts unite to a common oviduct, a slightly expanded chamber encircled by numerous unicellular glands; this opens into the posterodorsal angle of the common genital atrium (Fig. 13). There is no copulatory sac or seminal receptacle such as exists in many Turbellaria. Professor Dahlgren has observed the copulation, which resembles that of other Turbellaria, and has found that the penis after passing into the genital atrium through the genital pore discharges the sperm through the anterior wall of the atrium into the adjacent parenchyma. From here the sperm make their way through the parenchyma to the ovarian follicles. In all worms examined an abundance of sperm was found in the fibrous parenchyma of the ovarian follicles. Fertilization occurs as soon as the egg is ripe and ready for discharge.

Spherical capsules resembling those of planarians are laid and attached to some object. They are red-brown in color and surprisingly large compared to the size of the worm. As in planarians these capsules containing several ova and hundreds of yolk cells are formed in the genital atrium which becomes enormously distended during their secretion. The material of the capsule comes mainly from stored droplets in the yolk cells.

Fig. 16. *Hydrolimax grisea.* Photograph from life, by Prof. U. Dahlgren, Princeton University.

The conspicuous eosinophilous glands around the genital pore, usually known as caudal or cement glands, probably play some rôle in the laying and attachment of the capsules.

8. Taxonomic Considerations.—*Hydrolimax grisea* appears to fit into the family Plagiostomidae satisfactorily. This family is defined by Bresslau (1933) as Alloeocoela with pharynx variabilis, separate ovaries and yolk glands, follicular testes, anterior mouth, posterior common genital pore, and no accessory female structures. *Hydrolimax* differs from *Plagiostomum* in its follicular ovaries, from *Brachyposthia* in its unarmed penis, and from both in its massive granule vesicle. In external appearance *Hydrolimax* more nearly resembles *Alvaera* Bock, 1923 (= *Hallezia* Graff, 1908, preoccupied), than it does any other plagiostomid. Both have a cylindroid shape and creep upon a small part of the ventral surface. *Alvaera* also apparently has follicular ovaries and the eggs are surrounded by some sort of nutritive halo. Unfortunately the anatomy of *Alvaera* is very imperfectly known, since the only description is the old one of Jensen, 1878, luckily illustrated with some figures. From these

figures as well as Jensen's description it appears that the copulatory apparatus of *Alvaera* differs considerably from that of *Hydrolimax* having the granule complex reduced to a circle of granule glands embracing the exit of the seminal vesicle. It therefore appears that *Hydrolimax* is not congeneric with any other genus of the Plagiostomidae and even if it were, the name *Hydrolimax* has priority over all the others, so that the other names would have to be changed. No such change is necessary, however, since the characters of *Hydrolimax grisea* differ sufficiently from those of other plagiostomid species to justify the separation of this form into a distinct genus. Consequently Haldeman's name is retained as the valid name of the animal, and no other known species of Plagiostomidae are sufficiently like *H. grisea* to warrant their transfer to the genus *Hydrolimax*.

9. Generic Diagnosis of *Hydrolimax*.—Plagiostomidae with follicular ovaries and exceptionally large granule vesicle interposed between the seminal vesicle and the penis complex; otherwise similar to *Plagiostomum*. Type and only known species *H. grisea* Haldeman, 1842.

10. Distribution.—The type locality is a branch of the Susquehanna River in eastern Pennsylvania. Leidy found the animal in the Delaware and Schuylkill rivers near Philadelphia. The species at present occurs in some abundance around Princeton, New Jersey, and Dr. Charles Hadley brought me a specimen he collected near Montclair, New Jersey. Apparently *Hydrolimax* is limited to a region embracing New Jersey and eastern Pennsylvania.

11. Summary.—*Hydrolimax grisea* Haldeman, 1842, after having disappeared from notice for forty-five years has been rediscovered in New Jersey and found to be an alloeocoel of the family Plagiostomidae, the first fresh-water plagiostomid known for North America. *Hydrolimax* constitutes a valid genus of the Plagiostomidae and differs from the other genera of this family in the combination of follicular ovaries, unarmed penis, and extraordinarily large granule vesicle. In its general anatomy and histology it strongly resembles *Plagiostomum*.

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AMERICAN MUSEUM NOVITATES

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NORTH AMERICAN RHABDOCOELA AND ALLOEOCOELA. III[1]

MESOTOMA ARCTICA, N.SP., FROM NORTHERN CANADA

BY LIBBIE H. HYMAN

During a collecting expedition to the tundra near Churchill, in northern Manitoba, Canada (58° north latitude), in the summer of 1936, Mr. H. Elliott McClure of Peru, Illinois, secured large numbers of a mesostomid rhabdocoel which were sent to me for identification. Mr. McClure has written an interesting account of his collecting experiences on the tundra in The Beaver for March, 1937.

The rhabdocoel was found to be an undescribed species of *Mesostoma*, which is here named *Mesostoma arctica.* The material was not in very good histological condition and hence I am not able to furnish a detailed account of the histology. For the anatomy and histology of the mesostomids the splendid account of Luther (1904) constitutes a standard and the present species has been compared chiefly with his descriptions and figures. Gelei's recent redescription (1933) of *Mesostoma productum* has also proved helpful.

Mesostoma arctica, new species

Figures 1 to 5

EXTERNAL CHARACTERS.—The species attains a length of 4–5 mm. in life according to Mr. McClure but the preserved specimens were mostly about 3 mm. in length. The color is grayish brown or brown. The shape differs from that of other species of *Mesostoma* (Fig. 1). The anterior end is broad and blunt, almost truncate, and has a central depression bordered on either side by a projecting lip. From the anterior end the body width diminishes gradually to a slender tail; in preserved specimens this narrow tail is often sharply set off from the plump body but this seems not to be the case in life. The preserved specimens frequently showed angular margins but according to Mr. McClure these are not present in life but the animal is simply flattened below, con-

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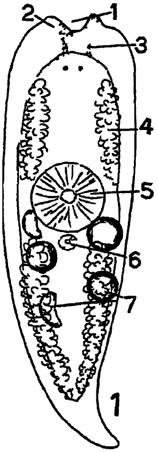
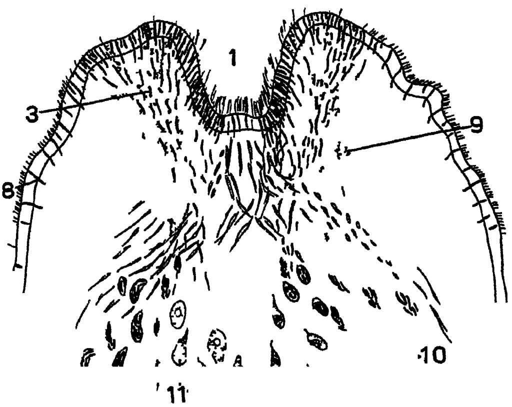
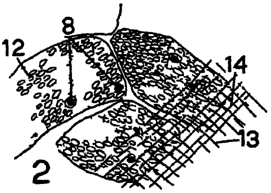
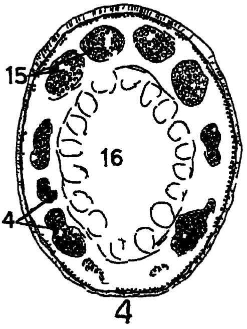
[1] The first and second papers of this series of articles were published in the Trans. Amer. Micro. Soc., LV, 1936, pp. 14–20, and in the American Museum Novitates, No. 1004, 1938.









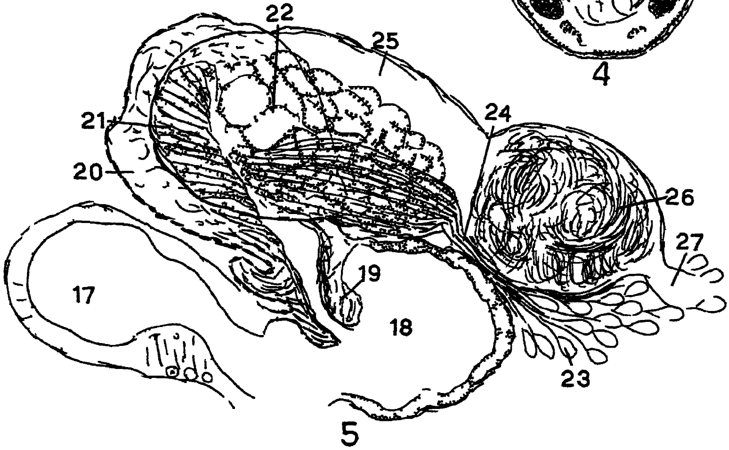


Fig 1 *Mesostoma arctica,* new species, constructed from several preserved specimens

Fig 2 Frontal section through anterior end to show anterior pit and rhammite tracts

Fig 3 Epidermal cells seen in tangential section, surface to the left, subepidermal musculature to the right

Fig 4 Transverse section to show location of testes and yolk glands

Fig 5 Male apparatus seen in sagittal view, anterior end of animal to the right

vex above. Cross-sections of the preserved worms were more or less circular, no doubt because of contraction on killing. Owing to the dark color very little of the internal anatomy could be made out on cleared stained or unstained whole specimens. There is a pair of eyes some distance behind the anterior pit and four elongated clusters of yolk glands could be seen, an anterior and a posterior cluster in lateral regions on each side. All the larger specimens contained several resting eggs in the posterior half of the body. These appeared dark brown in color in the preserved worms, but were stated by Mr. McClure to be a bright purplish red in life. In the preserved whole animals and in sections the eggs are hemispherical; this shape may be the result of collapse but this seems improbable because of the hard shells.

General Histology.—The surface is clothed with a ciliated cellular-epidermis which, so far as could be determined, closely accords with Luther's account. The epidermis is taller over the anterior end (Fig. 3) and dorsal surface (Fig. 4) than elsewhere. The structure of the epidermal cells is best seen in places where they happen to be cut tangential to the surface. Such sections show that the epidermal cells are large polygonal cells (Fig. 2) sharply marked off from each other, and filled with rhabdites of two sorts. One kind, termed rhammites by von Graff, is larger than the other and long and slender and somewhat sinuous. Each epidermal cell contains two or three to several such rhammites which are much longer than the cells and so extend into the underlying parenchyma (Fig. 3). The smaller rhabdites pack the basal half of the epidermal cells; they are said to originate within the epidermal cells while the rhammites come from special glandlike cells located in the parenchyma (Fig. 3). The distal part of the epidermal cells is finely granular and free from rhabdites. At their bases the epidermal cells appear to be continuous with the subepidermal circular muscle layer (Fig. 2).

The chief point of interest in the histology concerns the anterior depression or pit (Fig. 3). This was found to be simply a depression lined by epidermis differing from the adjacent epidermis of the anterior end only in that its cilia are noticeably longer. The pit is therefore probably in part a sense organ. The sides of the pit and also the bordering liplike projections differ further from the epidermis elsewhere in the large number of rhammites which penetrate them (Fig. 3). These rhammites are in fact the ends of two rhammite tracts ("Stäbchenstrassen" of German writers) which extend inward a short distance to their origin in clusters of rhammite-forming cells. Such single or paired anterior rhabdite tracts are of common occurrence in the genus *Mesostoma.* In *M. arctica* as also in other mesostomids the rhammite tracts are accompanied by the netlike outlets of cyanophilous glands whose bodies occur near the rhammite-forming cells. In preparations stained with Mallory's triple stain, the contrast between the red rhammites and rhammite-forming cells and the deep blue strands of the outlets of the cyanophilous glands is very striking. The cyanophilous gland cells themselves take a rather pale color in Mallory's stain and are filled with droplets and vacuoles.

In some mesostomids (as *Rhynchomesostoma rostratum, Mesostoma rhynchotum,* and *M. nigrirostrum*) there is at the anterior tip a small protrusible snout which can be withdrawn, thereby causing the formation of an anterior pit similar to that of *M. arctica.* The snout is then seen as a projecting eminence in the bottom of the pit. I could not find in *M. arctica* evidence of any such protrusible snout associated with the anterior pit but the general histology of the pit and bordering lips in *M. arctica* is similar to that of the snout and pit in the species mentioned and presumably serves the same purpose, namely, acting as a sensory and adhesive organ in the capture of prey. The muscular attachments of the pit of *M. arctica* indicate that the pit is protrusible to at least some extent.

Internal to the epidermis is found the usual subepidermal muscle sheath, consisting of outer circular and inner longitudinal fibers. Diagonal fibers, mentioned by Luther as common in mesostomids, appeared to be absent. A considerable number of muscle fibers are attached to the bottom of the pit. The condition of the preparations did not permit me to follow these very well but most seemed to proceed diagonally toward the ventral surface, there to join the subepidermal muscle sheath, while some coursed dorsally.

The parenchyma is in poor histological condition in all of the available series of sections.

SYSTEMS OTHER THAN THE REPRODUCTIVE SYSTEM.—Owing to the poor state of the material no attempt was made to study the nervous, excretory, or digestive systems. The two main excretory ducts could be found and had the relations typical of the genus *Mesostoma,* that is, they run transversely and open into the pharyngeal pouch. The mouth has the usual mid-ventral location and opens into a pharyngeal pouch (Fig. 6) to which is attached the typical rosette pharynx. The structure of the latter has been fully described by Luther and his predecessors and that of *M. arctica* appears to conform in all details to that of other mesostomids.

Reproductive System.—This system naturally follows in the main the plan of other mesostomids but shows a number of specific peculiarities. The testes are follicular consisting of numerous follicles situated along the mid-dorsal region for the entire length of the worm except the tail. In every cross-section (Fig. 4) several testis follicles are found. Their connections with the vas deferens were not seen. The numerous yolk glands occur in the lateral body regions ventral to the testes and as already remarked are arranged in four elongated clusters, two on each side anterior to the pharynx and two similarly situated behind the pharynx. The mid-ventral region is free of yolk glands (Fig. 4).

The copulatory complex (Figs. 5 and 6) is similar in its general plan to that of other species of *Mesostoma*. The common genital atrium joins the pharyngeal pouch to form a common chamber leading directly to the mouth, which thus also serves as genital pore. The genital atrium is a large cylindrical canal lined by a tall epithelium and provided externally with first circular and then longitudinal muscle layers. At its upper or dorsal end it receives on the right side the female organs, on the left the male organs, and posteriorly the uteri. In figure 6, an attempt has been made to show the entire copulatory complex in sagittal view with the female parts filled in and the male parts indicated in outline only. The details of the male parts are given in figure 5.

The male parts consist of anterior and posterior pouches of unknown function and a median penis continuing anteriorly into a granule vesicle and a seminal vesicle (Fig. 5). The penis is divisible as usual into a small penis papilla projecting into the roof of the genital atrium and a pyriform penis bulb. The detailed histological structure of these parts could not be ascertained exactly but appeared to correspond to Luther's and Gelei's descriptions. The penis papilla has muscular walls and probably a thickened cuticular lining, although the latter was not clearly seen. The penis bulb is covered externally with muscle fibers and receives two sorts of secretions. Its posterior wall has elongated chambers, bounded by what appear to be muscular partitions and filled with granules of cyanophilous secretion. Its anterior wall consists of large spaces bearing droplets of eosinophilous secretion. Both these regions are continuous with a large fusiform vesicle which I consider to be a granule vesicle. *Mesostoma arctica* appears to differ from all other species of *Mesostoma* in having a large granule vesicle distinct from both penis bulb and seminal vesicle. In other species, penis bulb, granule

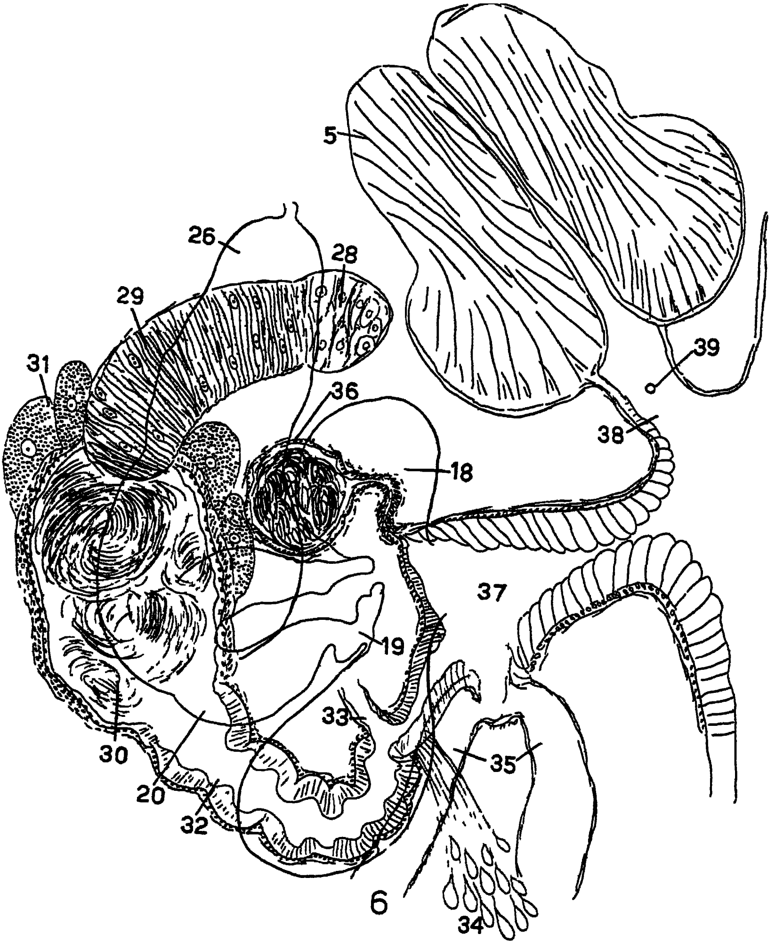


Fig. 6. *Mesostoma arctica*, new species. Sexual complex in sagittal view, constructed from several sagittal sections, anterior end of worm to the right.

1, anterior pit; 2, bordering lips of same; 3, rhammite tracts; 4, yolk glands; 5, pharynx; 6, genital atrium; 7, resting eggs; 8, rhammites; 9, outlets of cyanophilous glands; 10, rhammite-forming cells; 11, cyanophilous glands; 12, small rhabdites; 13, circular, and 14, longitudinal muscle fibers of subepidermal sheath; 15, testes; 16, intestine; 17, posterior pouch, and 18, anterior pouch of male part of atrium; 19, penis papilla; 20, penis bulb; 21, cyanophilous part of penis bulb; 22, eosinophilous part of penis bulb and granule vesicle; 23, granule glands; 24, bundle of their ducts; 25, granule vesicle; 26, seminal vesicle; 27, vas deferens; 28, ovary; 29, oviduct; 30, seminal receptacle; 31, gland of same; 32, common female duct; 33, yolk duct; 34, shell glands; 35, uteri; 36, copulatory bursa; 37, common genital atrium; 38, pharyngeal pouch; 39, entrance of excretory duct into same.

secretion, and seminal vesicle form together one bulb-shaped organ. The granule vesicle of *M. arctica* like the penis bulb contains two sorts of glandular secretion. Its ventral and central parts are made of cyanophilous secretion and is continuous posteriorly with the posterior cyanophilous wall of the penis bulb, and anteriorly with a conspicuous cluster of granule glands (Fig. 5). These granule glands occur below and behind the seminal vesicle; their ducts run forward in a bundle below the seminal vesicle and enter the anterior end of the granule vesicle at the junction of the latter with the seminal vesicle. The ducts inside the granule vesicle and penis bulb widen out into the elongated chambers filled with cyanophilous granules already mentioned. It thus appears that these chambers are the terminal parts of the ducts of the granule glands. The dorsal and lateral portions of the granule vesicle are occupied by large spaces bordered by droplets of eosinophilous secretion. This part of the granule vesicle is continuous with the similar spaces in the anterior wall of the penis bulb. The source of this eosinophilous secretion could not be determined; presumably the spaces must be connected with gland cells but none were found although such are said by Luther to be present.

At its anterior end the granule vesicle opens into the seminal vesicle, a rounded chamber packed with a mass of sperm and receiving the vas deferens at its anterior end. Both granule vesicle and seminal vesicle have muscular walls but no definite lining epithelium could be made out.

The female parts are similar to those of other species of *Mesostoma.* They comprise a copulatory bursa and the main female tract. The former is a round sac with a muscular wall inclosing a mass of sperm; it connects to the most anterior part of the dorsal roof of the common atrium by means of a curved duct. The copulatory bursa of *M. arctica* differs from that of most other species of *Mesostoma* in its rounded form and slender duct. In some of the specimens sectioned, the bursa was much larger than in the series from which Fig. 6 was drawn. The main female tract begins as a large duct entering the right posterior part of the roof of the genital atrium. It proceeds dorsally and then curves anteriorly to terminate near the pharynx in the ovary. The ovary as in other mesostomas is a small body containing flattened eggs and is continuous with the very characteristic oviduct composed of extremely flattened cells. Following the oviduct comes an expanded sac, the seminal receptacle, packed with sperm and larger in some specimens than shown in figure 6. Its oviducal end is encircled by large glands. From the seminal receptacle the common female duct curves ventrally to enter the genital atrium receiving just before this entry the yolk duct into its anterior wall and a cluster of shell glands into its posterior wall. The yolk duct proceeds anteriorly above the male apparatus but could not be traced very far.

The two uteri enter the posterior wall of the genital atrium just below the entrance of the common female duct. Each proceeds transversely and then turns posteriorly to run backwards in the lateral region of the body. The uteri are thus limited to the posterior half of the body and do not have anterior extensions as in some mesostomas. Each uterus in the fully-grown worms contained several conspicuous thick-shelled resting eggs. As already noted these have hemispherical shells.

HABITAT.—The worms were found in abundance in fresh-water pools on the tundra near Churchill, northern Manitoba, Canada, near the arctic circle (latitude, 58° N.), during July, 1936. These pools are either frozen or dry during the greater part of the year. Presumably the mesostomas hatch from the resting eggs as soon as water appears in the pools in June, grow up quickly to maturity, and produce an abundance of resting eggs which are destined to hatch the following spring.

Type: Cat. No. 263, American Museum of Natural History.

SUMMARY.—*Mesostoma arctica*, a new species from northern Manitoba, Canada, is distinguished from other species of *Mesostoma* by the truncate anterior end with a central depression whose sides receive the rhammite tracts, by the spherical form and slender duct of the copulatory bursa, by the presence of a distinct large granule vesicle interpolated between the seminal vesicle and the penis bulb, and by the separate entrances of granule glands and vas deferens into the male apparatus, the former entering the granule vesicle, the latter the seminal vesicle.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXIX[1]

NOTES ON NEW GUINEA BIRDS. IV

BY ERNST MAYR

This paper[2] continues my revisions of New Guinea genera, treating the genera *Megapodius* and *Talegalla* of the family Megapodiidae. The same methods are used as the preceding three installments (see Amer. Mus. Novit., Nos. 915, 939, 947).

MEGAPODIIDAE

NOTES ON THE GENUS *MEGAPODIUS*

Peters introduces this genus in the second volume of his check-list with the statement (footnote): "The genus *Megapodius* is badly in need of revision in order to determine the validity of many of the species and subspecies, their relationships and distribution." The truth of this statement became very evident to me when I attempted to arrange the various forms for my New Guinea Check-list. The opinions of the various authors were so widely diverging that it was necessary to prepare a partial revision of the genus, in order to come to some definite conclusions. The last revision of the genus was that of Ogilvie-Grant in the 'Cat. of Birds,' XXII, pp. 446–461, published in 1893. No subspecies were recognized in this study and even such distinct forms as *tumulus* were not recognized, because "the chain of intermediate forms between the extreme types is complete" [sic!]. Since then a number of discussions on the genus have been published, those of Siebers and Stresemann being the most valuable. During the last years of its existence the Whitney South Sea Expedition has collected an unparalleled series in the Solomon Islands, the Bismarck Archipelago, and in Micronesia. These large series have by no means facilitated my task, but they allow a much firmer basis for my conclusions.

The greatest difficulty, presented by this genus, is the tremendous individual variation of color and particularly of size. The differences between adults and immatures are not always well developed and small size of the tarsus is sometimes the only character by which an immature can be told. Bleaching and foxing is another factor which should not be underestimated. Particularly the gray of under parts and uppermost back loses in time its bluish luster and acquires a dull tone.

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[1] Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, 947, 977, and 986.

[2] Manuscript received by the editor on Feb. 4 1938.

The habits of these birds provide another difficulty. *Megapodius* is a social bird and is usually found in little clusters or colonies, some of which are widely separated from each other. The result is that we do not have uniform subspecies, but rather conglomerates of slightly different populations. When some of these populations live on small coral islands and others on the mountains of bigger islands, these differences are accentuated by vertical variation (see below, p. 13).

No arrangement of the forms of this genus is quite satisfactory. There is no question that the very different *pritchardii* should be regarded a full species and this is also true to a lesser degree for *laperouse* but all the other forms are quite similar to each other. Most modern authors would not hesitate to regard all of them as subspecies of one species, if there were not one serious difficulty. Two different forms of the species have been reported to live side by side on at least six different localities. Stresemann and Paludan (1932, Novit. Zool., XXXVIII, pp. 245, 246) have therefore suggested to break up the genus into a number of species and this suggestion was adopted by Peters (Check-list, II, pp. 4–6).

It seems to me that such a classification of the forms of this genus creates more difficulties than it removes. Forms which are exactly intermediate between two "species" are arbitrarily placed in one of the two. *M. macgillivrayi* is placed as subspecies of *reinwardt,* because it is also red-legged, although it agrees in all of its other characters (general coloration, bare forehead) much better with *cremita.* In the hybrid population of Dampier Island (between *affinis* and *eremita*) some specimens occur which happen to have the same combination of characters as it also occurs in *forsteni* from the Moluccas.

The uniformly dark gray form *freycinet* has been separated specifically from *reinwardt* even by some of those authors, like Hartert (1901, Novit. Zool., VIII, p. 138), who considered *affinis* and *eremita* as conspecific with *reinwardt.* But even *freycinet* is linked with *reinwardt* by an intermediate form, *M. geelvinkianus.* This form shows an approach toward *reinwardt* not only in the posteriorly reddish leg, but also by its brownish-olive greater upper wing-coverts and secondaries. A specimen described by Salvadori (*i*, p. 228, 'Orn. Pap. Mol.,' III) seems to be a hybrid between *geelvinkianus* and *affinis*.

This discussion will be sufficient to prove my point that there are no morphological characters that can be used to split the megapodes of the Papuan Region into several species, on the contrary, even the most different forms are connected by intermediates.

Now let us examine the argument of the coexistence of several forms at one locality. While we discuss the details we must keep one point in mind. There are considerable ecological differences between the various races, particularly in Geelvink Bay. Some of the races are restricted to the smaller coral islands, others to the larger continental islands, like Jobi. We have here exactly the same phenomenon as discussed by me under *Ptilinopus rivoli* in a recent paper (Amer. Mus. Novit., No. 947, p. 1).

One further difficulty is provided by the habit of the species to undertake extensive roosting flights in the evening from the mainland to small islands off the coast, as it has been observed by me in several places in New Guinea and in the Solomon Islands. It is thus possible that one might collect two forms on these small islands although only one of them is a breeder.

The following cases of coexistence of two forms of the genus *Megapodius* at one locality have been quoted in the literature.

1.—South New Guinea (Ibis, Suppl. II, 1915, p. 319). The actual facts are that the B. O. U. Expedition collected two specimens of *affinis* at the upper Utakwa River (2900 ft. and 4200 ft.) and 18 specimens of *duperryi* at the lower ranges of the Mimika, Kapare, Wataikwa, and Setekwa rivers. There is no evidence that the two forms live side by side without mixing. It seems as if *affinis* was at this locality the altitudinal representative of *duperryi*.

2.—Western Papuan Islands (Salvadori, 'Orn. Pap. Mol.,' III, pp. 220–224, 230–234).

The resident race of these islands is *freycinet*. There is, however, one record of *duperryi*. One ♀ from Batanta (June, 1875), collected by Bruijn, while all other eight birds collected on Batanta and Salawati belong to *freycinet*. It is exceedingly unlikely that specimens of *duperryi* nest on Batanta, this unique specimen was probably a straggler, if the locality is correct, which is always open to doubt with Bruijn skins.

3.—Vogelkop and off-lying small islands.

The bird of the mainland is *duperryi* and that of the off-lying small islands *freycinet*, as has been stated by Beccari (Salvadori, *op. cit.*, p. 234). This explains why Beccari found *duperryi* at Dorei Hum and *freycinet* at Pulu Hum and why both forms have been found at Sorong. As Siebers (Treubia, VII, Suppl., pp. 32–33) has already explained, it is probable that the *freycinet* specimens were collected on the island Sorong proper and other small islands of the vicinity and the specimens of *duperryi* on the nearby mainland.

4.—Dorey.

The common form of the vicinity of Manokwari (= Dorey) is *duperryi*, but von Rosenberg collected a specimen of *geelvinkianus* at Dorey on January 12, 1869 (see Schlegel, Musée Pays-Bas, VIII, p. 63). Whether this locality is wrong (von Rosenberg frequently made mistakes in his labelling) or whether the specimen was collected on one of the islands of the Bay of Dorey (such as Mansinam) or whether this is a straggler, is unknown, but there is no reliable evidence that *geelvinkianus* nests on the mainland. Not one of the numerous recent collectors has found it on the Vogelkop.

5.—Jobi.

The common form of the mainland of Jobi is *affinis*. This is the form collected by von Rosenberg (♂, ♀, April, May, 1860), by Beccari (1 ♂, Nov. 23, 1875), by Bruijn (6 specimens examined) and by Doherty (2 ♂, 1 ♀, Ansus and 1 ♀, Marai). But several authors also report *geelvinkianus* from Jobi. A. B. Meyer reports a young megapode from Ansus, Jobi, which shows no subspecific character because it is still in the juvenile plumage, but of which he assumed that it belongs to *geelvinkianus*, because he found this form on the other islands of Geelvink Bay (Numfor and Biak). In the light of our present knowledge it is more than probable that this specimen belongs to *affinis*. Aside from Meyer's "record," the occurrence of *geelvinkianus* on Jobi is based on two specimens (Salvadori, *h* and *i*) which were collected by Bruijn, and one of which is not even a typical specimen of *geelvinkianus*, but apparently intermediate between *geelvinkianus* and *affinis*. Bruijn is also the only collector who reports *Ptilinopus prasinorrhous* and *Cinnyris salvadorii* from Jobi, while all the other collectors obtained *Ptilinopus miqueli* and *Cinnyris sericea*, in all three cases producing great taxonomic difficulties. I am convinced that neither *Megapodius geelvinkianus*, nor *Ptilinopus prasinorrhous*, nor *Cinnyris salvadorii* was ever collected on Jobi, but that Bruijn obtained these species on some of the small islands off the coast of Jobi. There is no reason to change our whole system of the genus *Megapodius* just for some doubtful records of Bruijn. He was working mainly through Malayan and Arab collectors, who have reported many wrong localities, as has been pointed out by Salvadori again and again.

6.—Moroka district.

The Rothschild Collection possesses one specimen of *Megapodius affinis*, described by Hartert (1901, Novit. Zool., VIII, p. 136) under *duperryi* which was said to have come from the Moroka district in southeast New Guinea. The specimen is without an original label and was purchased by Lord Rothschild from a London dealer. The bird agrees perfectly with a series from the Mambare River and there is no doubt that it did not come from the locality given on the label. All the (large!) collections that have been made in recent years along the south coast of southeast New Guinea (lowland and mountains) contained only red-legged *duperryi*.

Summarizing all this evidence it can be said that there is no reliable evidence in existence to prove that two forms of *Megapodius* occur in exactly the same locality, without mixing. The fact that the most divergent forms, such as *reinwardt, freycinet,* and *eremita* are connected by intermediates makes it necessary to consider them all subspecies of one species. Historical developments have brought about the phenomenon that forms that have evolved in very different directions are now again close neighbors, as for example on the west coast of the Vogelkop, at the head of Geelvink Bay, and on the islands of Geelvink Bay, but the physiological divergence has nowhere proceeded to the point that these forms act like good species where they meet.

In fact the best proof for the assumption that all these forms are conspecific is furnished by the population of Dampier Island where the two very different forms *affinis* and *eremita* meet. These two forms do not live side by side as good species, but on the contrary they mix completely and form a hybrid population, as described below, p. 11.

The scope of this present series of papers is limited to revisions of Papuan birds. I shall therefore refrain from treating the western *nicobariensis* and *tenimberensis,* and the eastern *layardi,* all of which seem to be subspecies of *freycinet. M. laperouse* from Micronesia may be considered a separate species and *M. pritchardii* is unquestionably a good species.

Megapodius freycinet reinwardt Dumont

Megapodius Reinwardt DUMONT, 1823 (Dec. 27), Dict. Sci. Nat. (Levrault), XXIX, p. 416.—"Amboyna," error for Lombok (see Schlegel, 1880, Mus. Pays-Bas, VIII, p. 57).

Megapodius rubripes TEMMINCK, 1826, 'Pl. Col.,' livr. 69, Pl. 411.—Based on the same specimen.

Megapodius gouldii GRAY, 1861, Proc. Zool. Soc. London, p. 290.—Lombok.

Megapodius amboinensis GRAY, 1861, Proc. Zool. Soc. London, p. 293.—"Amboyna," error for Banda.

A pale form; under parts of a pale gray, which has a brownish tinge; flanks inconspicuously rufous brown mixed with gray; crest on head not very elongated (medium); crown and crest of a light brown, frequently with a distinct olivaceous tinge; back light olive-brown; on some islands specimens with a rufous back occur; wing-bend without gray; tail brown; legs yellowish red; forehead fairly well feathered; size medium.

RANGE.—Lesser Sunda Islands to Key Islands.

The above given diagnosis applies to this race only in a general way. The subspecies is really composed of a series of slightly different populations. To show the width of geographical variation within the *reinwardt* complex I shall give a detailed description of the birds from the various islands.

KANGEAN.—Very small, two probably immature birds, wing 206, 215, one certainly adult: 223 (♀).

LOMBOK AND FLORES.—Agree with the subspecies diagnosis. Wing, ♂ 227, 234, 235, 242, ♀ 238, 238.

SUMBAWA.—A single bird (♂ 227) is rather brownish.

DJAMPEA GROUP (Djampea, Madoe, Kalaotua).—In coloration and size like Lombok birds. Wing, ♂ 233, 242, ♀ 237, 238. Tarsus, 62, 62, 63, 68.

ALOR, WETTER, ROMA.—Like Lombok birds.

Alor, wing, ♀ 238, ○ 228.
Wetter, wing, ♀ 243
Roma, wing, ♂ 221, 244, ♀ 240, 245; tarsus, ♂ 63, 65, ♀ 59, 59.

DAMAR.—Average somewhat more rufous, ♂ 234, ♀ 232.

BABBER.—Average larger, darker, and more brownish. Wing, ♂ 245, 247, 247, ♀ 234. Tarsus, ♂ 65, 66, 69, ♀ 63.

SUMBA.—Very large, dark, and brownish. Wing, ♂ 243, 252, 253, 253; tarsus, ♂ 64, 66, 67, 69.

These specimens with their long brown crests, dark gray under parts and dark mantle are really closer to *duperryi* than to *reinwardt*. Two specimens collected recently (Stein, 1932) are more olivaceous, the two others collected by Everett 40 years ago are very rufous brown.

GREATER BANDA.—Small and quite rufous brown, but rather dark. Wing, ♂ 232, ♀ 226, 231; tarsus, ♂ 67, ♀ 63, 65.

KEY ISLANDS.—Small and rather olivaceous. Wing, ♀ 215, 226, 226, 229; tarsus, 61, 64, 64, 64.

SOUTHEAST ISLANDS (Koer, Kisoei, Kilsoein, Teoor).—Small, olivaceous, with a slight rufous tinge. One bird from Kilsoein and one from Teoor quite rufous.

Wing, ♂ 219, 220, 222, 223, 225, 227, ♀ 225, 225, 227, 232; tarsus, ♂ 61, 63, 65, 66, 67, 68, ♀ 62, 64, 65, 66.

Megapodius freycinet duperryi Lesson and Garnot

Megapodius duperryi LESSON AND GARNOT, 1826, Bull. Sci. Nat., VIII, p. 113.—Dorey, northwest New Guinea.

A medium-sized, rather dark form; under parts of a dark gray with a distinct bluish tinge; flanks more or less mixed with chestnut; crest very elongated; crown and crest dark brown, rarely with a rufous or olivaceous tinge; back very variable, most often dark olive brown with a distinct chestnut tinge; exceptional specimens are pure olive-brown or pure rufous brown; wing-bend without gray; tail and wing-feathers blackish brown; legs yellowish red (salmon-colored); forehead, upper throat, and sides of face well feathered.

RANGE.—West and south New Guinea, extending on the north coast as far east as the Wandammen district, then along the entire south coast, and extending westward along the north coast of southeast New Guinea as far as the Hydrographer Mts. and the Kumusi River.

WING LENGTH.—Arfak Peninsula, ♂ 234, 242, 242, 243, 251, ♀ 233, 236, 240; 243, 243; lower Snow Mts., ♂ 220, ♀ 215; Fly River, ♂ 223–242, ♀ 228–244, south coast of southeast New Guinea, ♂ 232, 233, 235, 236, 236, 241, 242, 243, 246, 247, ♀ 235, 246; north coast of southeast New Guinea, ♂ 242, 250, ♀ 233, 234, 241.

This is by no means a very distinct race, particularly in view of the great variation of *reinwardt*. The darkness and more chestnut color of the New Guinea birds is, however, quite evident if series are compared, and is true even for the old specimens collected by Bruijn and Beccari more than 60 years ago.

The distribution of *duperryi* is very curious. It is principally a lowland bird and it is represented in the mountains by *affinis* at two widely distant localities. One is the foothills of the Snow Mts., where *duperryi* occurs on the lower Mimika, Kapare, Wataikwa, and Setekwa rivers, and *affinis* on the upper Utakwa River, and the other locality is on the north coast of southeast New Guinea where *duperryi* occurs as far as the lower Kumusi River, while *affinis* was collected at the upper Mambare River. In the latter case it is also possible that the watershed between Kumusi and Mambare forms the border between the two subspecies.

Megapodius freycinet aruensis, new subspecies

TYPE.—No. 538976, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Trangan Is., Aru Islands; September 19, 1900; Heinrich Kühn.

Similar to *reinwardt*, but averaging smaller; crown, crest, mantle, wings, and tail brighter rufous brown; under parts darker gray. Differs from *duperryi* by smaller size and by having wings and tail brighter rufous, not chestnut or blackish brown.

Wing, ♂ 226, 227, 233, ♀ 235, 239; tarsus, ♂ 63, 63, 66, ♀ 66, 66.

This small-sized, bright rufous population is quite distinct from any of the other races. In coloration *aruensis* is most similar to *yorki* Mathews, but it is, of course, much smaller (wing 226–239, against 240–274 in *yorki;* tarsus 63–66, against 65–73). I do not know how it differs from *assimilis* Masters from the islands of Torres Straits because I have seen no material of that form. It is usually regarded as a synonym of *duperryi*.

Megapodius freycinet yorki Mathews

Megapodius reinwardt yorki MATHEWS, 1929, Bull. Brit. Orn. Club, L, p. 11.—Cedar Bay, about 27 miles south of Cooktown, at about 15° 52′ south latitude.

A large, light-colored form; under parts rather pale gray; crest long; crown and crest of a clear, bright brown, or rufous brown; uppermost back with a slight olive tinge; mantle and wings bright cinnamon brown with a rufous tinge; rump rufous; tail blackish chestnut; wing-bend without gray; legs reddish yellow; forehead, chin, throat, and sides of head well feathered.

Wing, ♂ 240, 250, 256, 262, 265, 267, 274, ♀ 243, 247, 249, 255, 257, 266; tarsus, ♂ 67–72 (69.6), ♀ 65–73 (68.8).

RANGE.—Cape York Peninsula and northern Queensland as far south as the Cooktown district.

This race was characterized by Hartert in January, 1929 (Novit. Zool., XXXV, p. 43) and named late in the same year by Mathews who practically copied Hartert's description. Although he named the race *yorki* and although there was a large series of Cape York birds available in the Rothschild Collection, Mathews unexpectedly chose as type locality Cedar Bay, which is in the Cooktown district and not on Cape York proper. The two specimens from Cedar Bay are fortunately not intermediate between the Cape York and the Cairns race, but quite typical of the Cape York race. The break between the two races apparently occurs between Cooktown and Cairns as in many other species.

Megapodius freycinet castanonotus, new subspecies

TYPE.—No. 200364, Amer. Mus. Nat. Hist.; ♀ ad.; Babinda Creek, south of Cairns; November 7, 1921; H. C. Raven Coll.

A medium-sized and dark-colored race; under parts dark gray, almost as blackish as in *tumulus;* crest long; crown and crest dark chestnut brown; hind-neck dark gray; mantle, wings, and rump chestnut; wing-bend without gray; tail blackish; legs and feet yellowish; forehead, chin, throat, and sides of head well feathered.

Differs from *tumulus* by its dark chestnut-brown (not olive-brown) back and from *yorki* by its dark coloration and chestnut back.

Wing, ♂ 247, 249, 251, 253, ♀ 230, 244, 256; tarsus, ♂ 65, 68, 68, 69, ♀ 64, 68, 70.

RANGE.—Cairns district in northern Queensland (1 ♀, Babinda Creek; 2 ♂, Mt. Sapphire; 2 ♂, Bellender Ker; 2 ♀, Allumbah; 1 ♀ imm., Bartle Frere).

Megapodius freycinet tumulus Gould

Megapodius tumulus GOULD, 1842, Proc. Zool. Soc. London, p. 20.—Coburg Peninsula.

Megapodius duperryi melvillensis MATHEWS, 1912, 'Austr. Av. Record,' I, p. 26.—Melville Island.

A very large and dark race; under parts of a dark, almost blackish, slate gray; flanks dark grayish brown; crest long; crown and crest dark fuscous brown; hind-neck dark gray; back dark brown with a distinct olive tinge, particularly on the upper back; wing-bend without gray; tail blackish; legs and feet yellowish red; forehead, chin, throat, and sides of head well feathered.

Wing, ♂ (mainland) 277, 278, 280, ♂ (Melville Is.), 252, 256, 262, 269; ♀ (mainland) 270, 276, 282, ♀ (Melville Island) 262, 272.

Tarsus, ♂ (mainland) 71, 72, 72, ♂ (Melville Is.) 71, 72, 72, 72; ♀ (mainland) 70, 70, 72, ♀ (Melville Is.) 67.

RANGE.—Melville Island and coast of Northern Territory (Port Keats, Daly River, Alligator River, Coburg Peninsula).

The measurements listed by me indicate that it might be advisable to recognize *melvillensis* on the basis of smaller size, if this difference is confirmed by more material.

Megapodius freycinet macgillivrayi Gray

Megapodius macgillivrayi GRAY, 1861, Proc. Zool. Soc. London, p. 289.—Duchateau and Pig islands, Louisiade Archipelago.

A medium-sized and very dark race; under parts of a dark, almost blackish slate gray; flanks with little or no brown; crest medium or short; crown and crest fuscous gray, with a slight brownish tinge; hind-neck dark slate gray; mantle and wings from dark brownish olive to grayish olive; wing-bend with gray; tail blackish; legs yellowish red, feet partly blackish; chin and throat fairly well feathered, forehead and vicinity of eye largely bare and blackish; feet and claws very heavy.

Wing, ♂ 227, 232, 235, 238, 239, 240, 242, 242, 243, 245; ♀ 220, 221, 229, 230, 237, 244, 246. Tarsus, ♂ 64, 65, 66, 67, 67, 69, 69, 72, 72; ♀ 64, 64, 65, 68, 69.—36 adults and 10 immatures examined. Some of the sexing is apparently not correct.

RANGE.—D'Entrecasteaux Archipelago (Fergusson, Goodenough and Dabu Is.); Kiriwina, Trobriand Is.; East Is., Bonvouloir group; Woodlark Island, Woodlark group; Dugumenu, Marshall Bennett Is.; St. Aignan; Sudest Island, Duchateau Island and Pig Island, Sudest group, and Rossel Island in the Louisiades.

Although the birds from the entire range are very dark, there is considerable variation in regard to the chestnut or olive coloration of the back. Most specimens from the D'Entrecasteaux Archipelago have a rufous brown admixture of crown, mantle, and wings. In birds from the Trobriand Islands (Kiriwina) the Marshall Bennett group (Dugumenu), the Bonvouloir group (East Is.), St. Aignan and Sudest Is., the olive coloration prevails, although occasional specimens still have quite a brownish wash. On Rossel Island and particularly on Woodlark Island, the two easternmost islands of either chain of the Louisiades, the darkest and most grayish-olive extreme has developed. The crown is blackish gray without brown or olive; the mantle is dark olive-gray and rump and upper tail-coverts are blackish brown, not chestnut.

The type locality of this form is Duchateau Island west of Sudest, which probably has an intermediate colored population. In view of the central position of the type locality, and in view of the considerable individual variation of the intermediate population, it seems best not to subdivide *M. f. macgillivrayi* Gray. The difference between eastern and western birds is probably due to the fact that the D'Entrecasteaux birds contain some *duperryi* blood and those from eastern islands some *brenchleyi* blood.

Megapodius freycinet affinis A. B. Meyer

Megapodius affinis A. B. MEYER, 1874, Sitzungsber. K. Akad. Wiss. Wien, LXIX, Abt. 1, p. 215.—Rubi, head of Geelvink Bay.

Megapodius decollatus OUSTALET, 1878, Bull. Assoc. Sci. France, XXXI (No. 553), p. 248.—Tarawai (= D'Urville Is. or Kairiru).

Megapodius duperreyi var. *jobiensis* OUSTALET, 1881, Ann. Sci. Nat., Zool. (6) XI, Art. 2, p. 96 (ex Schlegel Ms.).—Jobi Islands.

Megapodius brunneiventris A. B. MEYER, 1891, Abh. Ber. Zool. Mus. Dresden, 1890–1891, No. 4, p. 15.—Astrolabe Bay.

Megapodius reinwardt huonensis STRESEMANN, 1922, Journ. f. Ornith., LXX, p. 408.—Heldsbach Coast, Huon Gulf.

A small-to medium-sized race; under parts ashy gray, flanks, abdomen, and sometimes even the breast washed with brown; crest medium to long; crown and crest rather bright walnut brown, with a slight olive tinge; hind-neck ashy gray; mantle and wings dark olive-brown, usually without any rufous tinge; wing-bend without gray; tail blackish or blackish chestnut; legs and feet dark olive-green; forehead well feathered; chin, throat, and sides of head very sparsely feathered.

Differs from *duperryi* by its dark legs, bright olive-brown and not rufous brown coloration of the upper parts, and by the sparse feathering of the throat.

WING.—Makimi, head of Geelvink Bay (near type locality of *affinis*), ♀ ad., 222; Jobi Island, ♂ 218, 221, 222, 225, 227, ♀ 214, 220, 223, 223, 225; Hol, Humboldt Bay, ♂ 224, 229, ♀ 223. Astrolabe Bay, ♂ 227, 231, 232; Huon Peninsula, ♂ 225, ♀ 214; Bihagi, upper Mambare, ♂ 223, 230, 231, 233, 235; Vulcan Island, some of the birds possibly not adult, ♂ 217, 217, 218, 219, ♀ 219, 220, 233.

RANGE.—North New Guinea from the head of Geelvink Bay eastward to the Mambare River, extending along the slopes of the Nassau Range (south New Guinea) to the upper Utakwa River; Jobi, Vulcan Island, Tarawai, and other islands off the coast of north New Guinea.

There is no variation of color within this extensive range. Stresemann (1923, Arch. f. Naturgesch., 89A, 8 Heft, pp. 90, 91) admits 3 races within this range, *affinis* with a wing of 200–202, *decollatus* with a wing of 208–224, and *huonensis* with a wing of 226–235. The above quoted measurements prove that *decollatus* cannot be separated from *affinis* and also that the size difference between *huonensis* and *affinis* is so small that it seems unwise to recognize *huonensis*. The series of birds from the Mambare River is distinguished by particularly strong feet and claws.

Megapodius freycinet, subspecies

RANGE.—Dampier (Karkar) Island.

Off the coast of north New Guinea we find a series of three islands which connect in many ways the bird fauna of New Guinea and New Britain: Vulcan Island, Dampier Island, and Long Island. These three islands prove to be of the utmost importance in the study of the genus *Megapodius.* The westernmost island (Vulcan Is.) has a pure population of *affinis*, the easternmost island (Long Is.) has an almost pure population of *eremita*, and the intermediate island has a hybrid population.

There are 4 ♂ and 2 ♀ of *Megapodius* from Dampier Island in the Rothschild Collection. One of the males is almost indistinguishable from *eremita* and one of the females from *affinis*, the other four birds show a mosaic of the characters of the two "parent" races. This is best illustrated in a table in which the birds are arranged in the sequence of their similarity to *affinis* and *eremita.*

The Dampier series shows strong sexual dimorphism of coloration, while sexual dimorphism is very slight or quite absent in pure races of *Megapodius freycinet.* It is very curious that the females of this hybrid population are much closer to *affinis* and the males to *eremita.*

CHARACTERS OF HYBRID POPULATION ON DAMPIER ISLAND AND OF PARENT RACES

SPECIMEN	SEX	WING	CREST	FOREHEAD	BROWN ON FLANKS	MANTLE	WING
affinis	♂ ♀	..	long	feathered	very much	bright olive-brown	no gray
Dampier No. 134	♀	202	medium	feathered	very much	duller and more rufous	no gray
Dampier No. 135	♀	220	short	bare	much	very light olive-brown	no gray
Dampier No. 131	♂	228	long	feathered	much	duller	no gray
Dampier No. 133	♂	205	short	feathered	very little	darker and more olive-green	little gray
Dampier No. 130	♂	220	medium	partly bare	practically none	darker and more olive-green	little gray
Dampier No. 132	♂	218	short	almost bare	very little	very dark and olivaceous	little gray
eremita	♂ ♀	..	very short	bare	none	dark and olivaceous	much gray

Megapodius freycinet eremita Hartlaub

Megapodius eremita Hartlaub, 1867, Proc. Zool. Soc. London, p. 830.—Echiquier Islands (= Ninigo Islands).

Megapodius Brenchleyi G. R. Gray, 1870, Ann. Mag. Nat. Hist., (4) V, p. 328.—Gulf (= Ugi) Island, Solomon Islands.

Megapodius Hueskeri Cabanis and Reichenow, 1876, Journ. f. Ornith., p. 326.—New Hanover.

Megapodius rubrifrons Sclater, 1877, Proc. Zool. Soc. London, p. 556.—Admiralty Island.

A small and very dark race; under parts of a very dark slate gray; flanks dark gray with or without a slight olive-brown tinge; crest very short, sometimes hardly noticeable; hind-neck dark gray; back very dark olive-brown; wing with a considerable amount of gray; tail brownish black; legs and feet dusky olive-green turning blackish in the dried skin; forehead bright red, completely bare; sides of face and throat sparsely feathered.

Range.—Entire northern Melanesia from the Ninigo Islands in the west to Long and Rook Island in the south and to the easternmost Solomon Islands in the east.

I have examined more than 200 adult birds and several score juvenals from this range and have come to the conclusion that it is impossible to recognize any races. If only a series from the Ninigo Islands is compared with a series from the mountains of San Cristobal, Solomon Islands, they are about as different as any two subspecies are in this genus. But not far from San Cristobal on the smaller islands of the Solomons we find populations which cannot at all be separated from Ninigo birds.

Four adult specimens from San Cristobal are not only very much larger than typical Ninigo birds (wing, ♂ 226, 238, 240, 244, against ♂ 201–219) but differ also in coloration. The gray of neck and under parts, and the brown back and wings are much lighter. The brown of the upper parts is more rufous, less olivaceous, the wing has usually less gray, and the throat is more densely feathered. Crest and crown are bright brown and differ conspicuously from the rest of the head.

Birds from the neighboring small island of Santa Anna are still more rufous on the upper parts and particularly on the wings. They are very small (♂, wing 215, 217, 221, 224). Since birds from Ugi Island, the type locality of *brenchleyi*, from where we have no material, usually agree with Santa Anna birds, we may assume that the just given characters probably also apply to Ugi birds.

Birds from most of the other islands of the Solomon group, particularly those from the larger islands, like Guadalcanar, Ysabel, Choiseul, Bougainville, and the New Georgia group are intermediate, but closer to the *brenchleyi* type. Birds from some of the smaller islands, like Nissan and Ramos are closer to the *eremita* type, and birds from Gower Island and from Ongtong Java cannot with certainty be separated from the Ninigo series. Birds from Manus, Admiralty Islands, are quite indistinguishable from Ninigo birds, and birds from New Britain and the other islands of the Bismarck group, though equally dark, are slightly more brownish, less olivaceous above.

Of six birds from Rook Island, the four males are dark and dull, agreeing rather closely with Ninigo specimens. The two females are brighter showing a certain tendency toward *affinis.* The under parts of both birds are as in *eremita.* One of the males and one of the females have the forehead slightly more feathered than other specimens of *eremita.* This indicates that there is some *affinis* blood in the Rook Island population.

Not only on Rook Island, but practically all over the range of *eremita*, a certain amount of sexual dimorphism is apparent. Males are not only larger, but also darker and more olivaceous on the mantle. Females are brighter and more brownish.

The size variation can be summarized about as follows: The largest population occurs in the mountains of San Cristobal and probably in the mountains of the other large islands of the Solomon Islands. Fairly large-sized populations occur in the lowlands of the large islands, while the small islands have populations of small size, the smallest occurring in the most isolated coral islands.

In view of the considerable individual variation and in view of the irregularity of geographical variation, it seems better not to recognize *brenchleyi* but to call all the birds of northern Melanesia *eremita.* If *brenchleyi* were recognized, its range would include only the larger islands of the Solomons and even there it would comprise very unequal populations.

Megapodius f. forsteni appears to be exceedingly similar to *eremita.* It differs only by averaging lighter, by having more rufous brown on abdomen and flanks, and by having the bare forehead black instead of reddish.

The variation of size of the various populations included under *eremita* will be illustrated by the following table of measurements.

Measurements of *M. f. eremita*

All obviously immature birds have been excluded from this tabulation.

Ninigo Islands.—Wing, ♂ 201, 206, 209, 210, 212, 213, 215, 216, 217, 219, 219, ♀ 198, 204, 205, 205, 206, 208, 214, 214; tarsus, ♂ 56–63 (59.0), ♀ 54–62; claw, 19–22.

Admiralty Islands.—Wing, ♂ 208, 213, 214, 215, 215, 217, 218, 219, 221, 222, 222, ♀ 210, 211, 213; tarsus, ♂ 57–65 (60.5), ♀ 58, 59, 60.

Rambutyo, Admiralty Is.—Wing, ♂ 205, 216, 220, ♀ 202.

Witu Islands.—Wing, ♂ 214, ♀ 214, 215, 221.

Squally Island.—Wing, ♂ 229; tarsus, 67.

New Hanover.—Wing, ♂ 217, 235, ♀ 220, 223; tarsus, ♂ 64, 70, ♀ 58, 64.

New Ireland.—Wing, ♂ 217, 221, 225, 229, 233, 234, ♀ 224; tarsus, ♂ 63–68 (66.0).

New Britain.—Wing, ♂ 212, 212, 213, 216, 216, 219, 219, 220, 221, 223, 225, 227, 228, 235, ♀ 212, 214, 216, 218; tarsus, ♂ 59–68, ♀ 58–65; claw, ♂ 20–23.

Rook Island.—Wing, ♂ 210, 211, ♀ 218; tarsus, ♂ 61–64 (62.5), ♀ 60, (63.5).

Long Island.—Wing, ♂ 218, 222, 224, 226, 230, ♀ 215, 218, 221, 221, 226; tarsus, ♂ 65–69 (66.6), ♀ 55–61 (59.0).

Tabar Island.—Wing, ♂ 214, 230; tarsus, 62, 63; claw, 21.

Tanga Island.—Wing, ♂ 223; tarsus, 62, claw, 22.

Lihir Islands.—Wing, ♂ 213, 213, 217, 218, 218, 219, 225, 231, ♀ 217, 224, 226; tarsus, ♂ 65–67 (66.0), ♀ 60, 61, 61; claw, ♂ 20.5–23, ♀ 22–23.

Feni Island.—Wing, ♂ 216, 216, 218, ♀ 222, 229; tarsus, ♂ 58–63, ♀ 56–62.

Nissan.—Wing, ♂ 217, 218, 221, 222, 223, 223, 224, 226, 229, 229; tarsus, ♂ 63–66 (64.8), claw, 21–23.

Smaller Islands of the Solomon Islands.—Oema Island (near Bougainville), wing, ♂ 233; tarsus, 72; Poharan Is. (near Bougainville), wing, ♂ 235; Whitney, Island (near Shortland), ♀, wing, 211, 214, tarsus, 60, 61; Gower Island, wing, ♂ 210, 220, ♀ 208, tarsus, ♂ 63, 66, ♀ 59; Ramos Is., wing, ♂ 217, 218, 218, ♀ 217; tarsus, ♂ 67, 68, 70, ♀ 63; Beagle Island (near Guadalcanar) wing, ♂ 228, ♀ 218, tarsus, ♂ 70, ♀ 64; Komanchu Island, ♀, wing, 217, 231, tarsus, 64, 66; Santa Anna, wing, ♂ 215, 217, 221, 224, tarsus, 66, 68, 69, 69; Pavuvu group, wing, ♂ 219, 220, 233, ♀ 216, 223; Shortland Is., wing, ♂ 220; Fauro, ♀ wing, 222, tarsus 65; Savo, wing, ♂ 220, ♀ 220, 232.

Larger Islands of the Solomon Islands.—Bougainville, wing ♂ 217, 223, 224, ♀ 214, 217, 225, tarsus, ♂ 62, 64, 67, ♀ 60, 63, 63; Choiseul, ♂ 221, 228, 233; Ysabel group, wing, ♂ 222, 225, 227, 228, 229, ♀ 206, 218, 221, 226, 230, 231, 231, 233; Central group (Vella Lavella, Ganonga, Narova, Rendova, Kulambangra, etc.) ♂ 207, 210, 217, 222, 223, 225, 228, 231, 237, ♀ 200, 206, 216, 217, 222, 223, 223 (the smallest of these birds are probably not fully adult); Guadalcanar, ♀ wing, 214, 220, 222, 227, tarsus, 64, 64, 64; San Cristobal, wing, ♂ 226, 238, 240, ♀ 244, tarsus, ♂ 67, 68, 70, ♀ 77.

Weights (San Cristobal), ♂ 700, 750, 750, ♀ 925 gr.

All wing measurements are those of the primaries, although the secondaries sometimes appear longer. The measurements of the tarsus are sometimes approximations. It is not always possible to get exact tarsus measurements.

The systematic status of *Megapodius freycinet layardi* Tristram (New

Hebrides), of *M. f. geelvinkianus* Meyer (Biak, Numfor, and Miosnom), of *M. f. forsteni* Gray (southern Moluccas, except Buru) and of *M. f. buruensis* Stresemann (Buru) is clear and requires no further discussion. Salvadori ('Orn. Pap. Mol.,' III, p. 234) describes the variation in size of *M. f. freycinet.* I have not seen enough additional material to add anything to his analysis.

There are five principal characters that help to distinguish the various races of *Megapodius freycinet*, the color of back, wings, and feet, the feathering of the forehead and the length of the crest. It is interesting to see that these characters are not closely linked. The following table illustrates the variation of these characters in the more important races of *freycinet.* Such a tabulation will be helpful to the student of speciation.

Variation of Characters in Some Races of *Megapodius freycinet*

	Feet	Forehead	Back	Wing-bend	Crest
reinwardt	red	feathered	light rufous olive	without gray	long
tumulus	red	feathered	dark olive	without gray	long
affinis	blackish olive	feathered	light brown	without gray	long
macgillivrayi	red	partly bare	brownish olive	with gray	medium
forsteni	blackish olive	feathered	brownish	with race of gray	short
eremita	blackish olive	bare	dark brownish olive	gray	short
geelvinkiana	partly red	feathered	blackish with little brown	gray	short
freycinet	blackish	feathered	blackish gray	gray	short

Talegalla Lesson

The three species of this genus, in its modern restricted sense, are so similar that such an able ornithologist as Schlegel in 1880 considered one (*fuscirostris*) a synonym of *cuvieri* and the other (*jobiensis*) a subspecies. It is now known that these species differ much more than was realized in those days (see Ogilvie-Grant, 1915, Ibis, Suppl., pp. 322–324). Furthermore, the ranges of all three overlap without any evidence of mixing or intergrading.

The westernmost species, *cuvieri*, has no subspecies; the two more eastern species show a slight geographical variation of size which necessitates the description of a new race.[1]

Talegalla fuscirostris occidentis White

Talegalla fuscirostris occidentis WHITE, 1938 (October), Ibis, p. 73.—Setekwa River, Dutch New Guinea.

Similar to *fuscirostris*, but smaller in all measurements.

T. f. fuscirostris.—Wing, ♂ *280*,[2] 282, *285*, 290, 292; ♀ 268, 272, 275, 275, 278, *280*, 283; tail, ♂ *169*, 177, *179*, 186; ♀ 168, 171, 172, 174, 177.

T. f. occidentis.—Wing, ♂ 259, 264, 265, 266, 268, 270, 271, 272; ♀ 263, 264, 274; tail, ♂ 142, 146, 147, 152, 152, 160, 160; ♀ 145, 146.

RANGE.—Aru Islands and southwest New Guinea, from the head of Geelvink Bay (presumably belonging to this race) and the Mimika River eastward at least to the Oriomo River.

It has been known for almost 60 years that these birds are smaller than typical *fuscirostris*. Salvadori points it out for Aru Island birds in his immortal 'Orn. Pap. Mol.,' III (1882), p. 248, and Ogilvie-Grant records an equally small size for birds from the foot of the Snow Mts. (Ibis, Suppl., 1915, p. 324). I have measured more extensive material than either of these authors had available and found the differences fully confirmed. In regard to the tail measurements there is no overlap between the two forms, and the slight overlap in the wing measurements of the females may be due to faulty sexing.

Talegalla jobiensis longicauda A. B. Meyer

It has been questioned by several authors, whether this form was separable from typical *jobiensis*. It may be worthwhile to publish some measurements which demonstrate conclusively the larger size of *longicauda*. There is no difference in coloration.

T. j. jobiensis.—Wing, ♂ 261, 267, 271, 274, 281, 282, 285, ♀ 257, 272, 275, 276, 286; unsexed 261, 266, 279, 280, 286, 291.

Tail, ♂ 154, 155, 157, 157, 160, 167, ♀ 146, 150, 152, 152, 159, 161; unsexed 147, 158, 163, 163, 168, 169.

T. j. longicauda.—Wing, ♂ 281, 282, 285, 285, 292, 296, 302, 302, ♀ 280, 288, 292; unsexed 290, 294, 298.

Tail, ♂ 175, 177, 181, 184, 185, 185, 192, 204, ♀ 164, 174, 188; unsexed 171, 171, 186.

RANGE.—Southeast New Guinea, westward in the north to the Sepik River, in the south to the Aroa River.

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[1] This race was described by Mr. C. M. N. White while the present paper was in press and I have substituted his name. Nevertheless, it seems worthwhile to record the measurements of the specimens in the American Museum collections.

[2] Figures in italics from Salvadori (1882) and Ogilvie-Grant (1915).

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XL[1]

NOTES ON NEW GUINEA BIRDS. V

By Ernst Mayr

This paper[2] contains a continuation of my revisions of New Guinea birds, treating certain genera of the families Turnicidae, Rallidae, Charadriidae, Recurvirostridae, and Burhinidae.

TURNICIDAE

Turnix maculosa (Temminck)

I agree with Rensch (1931, Mitt. Zool. Mus. Berlin, XVII, p. 476) that the *sylvatica*-group and the *maculosa*-group are different enough to be regarded as different species, even though they represent each other geographically. No final revision of *Turnix maculosa* is yet possible, because most forms are represented by only a few specimens. Still, the Whitney S. S. Expedition has collected some previously undescribed specimens, which seem worth discussing.

Turnix everetti from Sumba has nothing to do either with *sylvatica* or *maculosa*. It is a distinct species with a distant relationship to *T. pyrrhothorax*.

Turnix maculosa maculosa (Temminck)

Hellmayr (1914, Avifauna Timor, pp. 94–95) has shown that this is the oldest name of the form from the Lesser Sunda Islands, and not *rufescens* Wallace, as Rensch assumes (*op. cit.*, p. 475). This form is quite different from the Australian race as I shall discuss in detail in a later publication.

Turnix maculosa melanota Gould

This is probably the correct name of the East Australian race, although *melanota* was described from Tasmania and I have not seen any Tasmanian specimens.

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[1] Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, 947, 977, 986, and 1006.

[2] Manuscript received by the editor on Feb. 12, 1938.

This race, as shown by adult females from New South Wales, is distinguished by its rather pale coloration, throat and center of belly being white. There is a pale or deep rufous breast-band and the sides of the breast are heavily spotted. The superciliary and the sides of the head are pale buffy. The feathers of the crown have narrow gray edges and the pale line along the center of the crown is not always well developed. Some of the feathers of the nuchal band have gray margins. The upper parts are quite variable; the edges of upper wing-coverts and scapulars are pale buff; the black spots on scapulars and back are rather large and the gray areas in between rather dull and dusky; there is a liberal amount of rufous on the back of most specimens; wing (♀), 80–84, occasionally up to 89.

RANGE.—Tasmania, southern and eastern Australia.

Turnix maculosa yorki Mathews

The unique type is on the upper parts rather heavily marked with blackish. It can be practically matched in this respect by two or three specimens from New South Wales. In every other respect it agrees perfectly with New South Wales birds, which would have to be called *yorki* if they should prove different from Tasmanian birds.

Turnix maculosa horsbrughi Ingram

Turnix horsbrughi INGRAM, 1909, Bull. Brit. Orn. Club, XXIII, p. 65.—Yule Island, Brit. New Guinea.

Size small, wing 71–81, against 80–89 in *melanota;* deep tawny collar of hindneck solid, and very conspicuous; similar to *maculosa,* but lores, superciliary, and sides of face bright orange-ochre, not pale buff; light edges of scapulars and upper wing-coverts rich ochraceous, not buffy; under parts more deeply colored, the rufous of the breast reaching upper throat and chin and extending along the flanks to the thigh feathers and crissum; in the type specimen even the middle of the belly is quite rufous; the upper parts appear darker on account of the heavier black vermiculation and spotting; gray edges of the black feathers of the crown rather narrow.

RANGE.—South New Guinea from the Fly to the Aroa River; Sudest group of Louisiade Archipelago.

This is one of the rarest *Turnix.* I believe there are only 5 (or 6, if Ramsay's bird is included) adult females of this race in collections. These come from widely separated localities and differ appreciably inter se. It seems therefore advisable to describe them in detail.

TYPE. ♀ ad.—Agrees with the above given description, but it is very rufous underneath; the black spots on the back and the upper wing-coverts are very large; there is very little gray or rufous mottling on the back; wing 74.

♀ ad.—Lower Aroa River, Dec. 6, 1904, A. S. Meek.—Similar to the type, but middle of belly whitish; back very blackish; dividing line on crown well developed; wing 81, tarsus 23.

2 ♀ ad.—Tagula Is., Feb. 21, 1929, and Yiena Is., 6 mi. n. of Tagula, Feb. 22, 1929, Hannibal Hamlin, Whitney South Sea Expedition.—Smaller and more deeply

colored; breast very deep rufous; back and scapulars strongly mottled with chestnut-tawny; dividing line on crown washed with orange-buff; ochraceous edges of wing-coverts broad; lower belly light buff; wing 71, 72; tarsus 19, 20.

It is quite possible that the birds from South New Guinea (Fly River) (Archbold Collection), from southeast New Guinea (*horsbrughi*) and from Sudest Island really represent three different races, but the material at hand at the present time does not permit their separation.

Turnix maculosa salomonis, new subspecies,

TYPE.—No. 329076, Amer. Mus. Nat. Hist.; ♀ ad.; Guadalcanar, Solomon Islands; June 2, 1927; R. H. Beck (Whitney South Sea Expedition).

Size large (wing 85 mm.); similar to *horsbrughi*, but deeper rufous underneath, particularly on the flanks and on the middle of the belly; rufous collar of hind-neck well developed; gray edges of feathers of crown very broad, almost completely hiding the black centers of these feathers; dividing line inconspicuous; upper parts similar to that of *horsbrughi;* principal color of back dark gray with rather large black spots and narrow vermiculation; outer edges of tertials and upper wing-coverts deep ochraceous; differs from *saturata* by the more grayish, less blackish back and by the presence of a rufous nuchal collar. Iris white, bill and feet yellow; gonads enlarged (laying).

Wing 85; tail 30; tarsus 20.

RANGE.—Only known from the unique type.

The Guadalcanar bird not only constitutes the first record of this species for the Solomon Islands, but it is sufficiently different from the neighboring races to be described as new. In general coloration it resembles, curiously enough, more the New Guinea race than *saturata* from the Bismarck Archipelago. It is, of course, much larger than *horsbrughi.* I am indebted to Mr. Kinnear for a comparison of this specimen with the types of *saturata* and *horsbrughi* and for his comments on the position of the Solomon Island bird.

Turnix maculosa saturata Forbes

This rare bird was not obtained by the Whitney S. S. Expedition, although it was reported at one time to be common at the Duke of York Islands.

Its principal characters are the blackish upper parts and the reduction of the rufous collar which is absent in two out of three adult females in the British Museum and inconspicuous in the third; the under parts are colored very deeply; central stripe on crown indicated in one bird, absent in the other two.—Wing 85, 85, 85.

RANGE.—New Britain, Duke of York Islands.

RALLIDAE

Rallus (Hypotaenidia) philippensis Linnaeus

This species, although it is very common on many of the Polynesian and Melanesian islands, is one of the rarest birds in collections from New Guinea. There are little more than a dozen New Guinea specimens known. This makes the classification of these birds rather difficult and is the reason why most of these specimens have simply been recorded as "*Hypotaenidia philippensis australis.*" With a great deal of material from other localities available it becomes apparent that the species is not as variable as has been claimed in older papers and that a good deal of what has been called individual variation is really geographical variation. The New Guinea birds before me belong to at least three different races, one in south and west New Guinea (near *yorki*), one in north New Guinea (related to *meyeri*) and one in northeast New Guinea (near a new race from Long Island). This preliminary arrangement of the New Guinea forms will probably have to be modified when more material becomes available.

Rallus philippensis yorki Mathews

This race was described as follows (1913, Austr. Av. Record, II, p. 6.—Cape York): "Differs from *E. p. australis* in its smaller size and in having the buff on the chest much darker." There is only one specimen from Cape York in the Mathews Collection and this will have to be considered the type. There are also in the Rothschild Collection two birds from Mackay and one from "Queensland" which might be referred to the same race. They measure: wing 131, 134, 140, tail 60, 61, 61; bill from lateral feathering 25, 25, 25; tarsus 36, 37, 38, 38.

A single bird from Cairns, north Queensland, is so large that it must be considered a migrant from Tasmania or South Australia (wing 152, tail 70, tarsus 42). If it were a resident bird, we would have to assume that all the other north Queensland birds are immature, which is not probable.

Two birds from south Queensland (Brisbane and Eldersleigh) have the same measurements as a series of birds from Botany Swamps, near Sydney, N. S. W. This series of *australis* measures:

Wing, ♂ 144, 145, 147, 150, 152, 154, ♀ 145, 147; tail, ♂ 62, 67, 68, 69, 70, 73, ♀ 62, 65; bill, ♂ 25. 27, 28, 28, 29, 29, ♀ 29, 30; tarsus, ♂ 38, 39, 40, 40, 40, 40, ♀ 40, 41.5.

These measurements show that north Queensland birds are distinctly smaller than such from south Queensland and New South Wales.

There is very little difference between *yorki* and *australis* in regard to pattern and coloration. Both are rather pale forms with a well-developed pectoral band; the crown is hair brown though sometimes rufous in *yorki*, heavily streaked with black; the prevailing coloration of the upper parts is olive brown, liberally spotted with white and with relatively little black; usually little or no white on lower back and upper tail-coverts. *R. p. yorki* seems to have the back more heavily spotted, the crown more rufous, the pectoral band deeper ochraceous and the black bars on the underside more conspicuous. The difference is, however, slight.

There are four other specimens in the Rothschild Collection which must be referred to *yorki*, until more material is available from the respective localities.

♂ ad.—Head of Geelvink Bay, July, 1920, Pratt Coll.

Wing and tail molting; bill 29; tarsus 43.

Crown not very rufous; white bars on upper back, more or less interrupted in the middle; little spotting of white on rump and tail; under parts very pale; the breast band interrupted in the middle, the rufous feathers being replaced by pure gray ones; otherwise as *yorki*.

♂ ad.—Tual, Kei Islands, September, 1897; H. Kuhn.

Wing, 138; bill, 28; tarsus, 39.

Similar to *yorki*, but general color of upper parts more brownish, less olivaceous; white spots on upper back numerous but small; breast band well developed, but each feather with a few dark bars; breast and abdomen heavily barred.

♂ ad.—Amboina, Moluccas, February, 1906; H. Kühn.

Wing, 142; tail, 62; bill, 26; tarsus, 40.

On the upper parts considerably darker than *yorki* and with the white spotting much reduced; no white spotting on lower back and rump; crown hair brown with heavy black shaft streaks; hind-neck deep rufous with numerous blackish spots; pale ochraceous breast band broad and with fine black vermiculations; barring of breast and belly rather coarse and with the black bars as wide as the white; the edges of the feathers of the back are quite olivaceous. Although darker than the known specimens of *yorki*, this bird does not approach the dark forms *lesouefi* and *meyeri* of the Bismarck Archipelago.

♀ ad.—Wahai, Seran, Moluccas, August, 1911. E. Stresemann.

Wing, 125; bill, 24; tarsus, 39.

Crown rufous; general coloration of upper parts very brownish and rather dark; upper back finely spotted with white; very little white on rump and upper tail-coverts; breast band very wide; middle of breast and belly very pale, with the dark bars almost obsolete; sides of breast and flanks heavily barred with black.

These birds from the Moluccas represent probably endemic races which cannot be described, however, without more material.

Bangs and Peters (1926, Bull. Mus. Comp. Zoöl., LXVII, p. 423) have recorded two specimens from South New Guinea, which they refer to *yorki*. The measurements, particularly those of the tarsus, of these birds seem to be still smaller than in *yorki*, but they are perhaps immature.

Rallus philippensis lacustris, new subspecies

TYPE.—No. 535134, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Ifar, Sentani Lake; September 25, 1928; Ernst Mayr Coll.

A large and rather dark form with the pectoral band well developed; black bars of flanks much broader than white ones, lower abdomen barred in three out of four birds; brown edges of feathers of crown rather narrow and rufous; uppermost back blackish heavily marked with small white spots; fewer, but larger white spots on scapulars and upper wing-coverts; middle of back, rump, upper tail-coverts and tail-feathers little or not spotted with white.

Differs from *meyeri* by having the edges of the feathers on the back narrower and more grayish olive, less brownish; by having the uppermost back more blackish; by being more heavily spotted with white on the upper parts, particularly scapulars and upper wing-coverts and by being more coarsely barred underneath.

Wing, 3 ♂ ad. 147, 148, 154, 1 ♀ ad. 147; tail, ♂ 65, 68, 69, ♀ 62; bill (from lateral feathering), ♂ 30, 30, 31, ♀ 27; tarsus, ♂ 44, 44, 46, ♀ 41; weight (in gr.), ♂ 210, 225, 240, ♀ 185.

RANGE.—North New Guinea (only known from the type series).

The four specimens from the Sentani Lake form a rather uniform series. It is unknown how far the range of this form extends. Three single specimens are known from farther east in New Guinea, which differ from *lacustris* by their darker, more blackish coloration above and below, by having the upper back barred with white, instead of spotted, and by having the breast band much less developed. All three birds agree in their essential characters with the population from Long Island and may be referred to that race until more material is available.

Rallus philippensis reductus, new subspecies

TYPE.—No. 422518, Amer. Mus. Nat. Hist.; ♂ ad.; Long Island, near northeast New Guinea; November 15, 1933; W. F. Coultas (Whitney South Sea Expedition).

Similar to *admiralitatis*, but larger, particularly with longer bill and tarsus; upper back more blackish; white on upper back in form of bars, not spots; tertials, lower back, rump, upper tail-coverts and tail-feathers with little or no white; ochraceous breast band absent or inconspicuous; if present barred with black like the rest of the under parts; barring of breast and abdomen rather narrow with black and white bars of about equal width; unbarred area on lower abdomen present.

Differs from *meyeri* by the reduction of the breast band and the prevalence of black and white on the upper back, differs from *lesouefi* by the reduction of the breast band, by the narrower black bars on the abdomen and by the reduction of white on the lower back.

Wing, ♂ ad. 141, 147, 148, ♀ ad. 137, 137; tail, ♂ 61, 63, 65, ♀ 55, 58; bill, ♂ 29, 32, 33, ♀ 27, 28; tarsus, ♂ 43, 45, 48, ♀ 40, 42.

RANGE.—Long Island and (subsp. ?) coast of northeast New Guinea from Astrolabe Bay to China Straits.

The three New Guinea specimens, which I am referring temporarily to *reductus*, may be described as follows:

♀ ad.—Madang, Astrolabe Bay; August 17, 1928; R. H. Beck.

Wing, 142; tail, 67; bill, 27; tarsus, 41.

A very dark bird; crown rufous with very heavy black streaking; edges of feathers of lower back and of inner wing very brownish; rump and upper tail-coverts with many small white spots; breast band narrow, interrupted in the middle and all rufous feathers heavily barred; center of abdomen unbarred, flanks heavily barred, with the black bars about twice as wide as the white ones.

♂ ad.—Giriwu River, near Buna, Collingwood Bay; Oct. 5, 1907. A. F. Eichhorn Coll.

Wing, 145; tail, 66; bill, 32; tarsus, 44.

Very similar to the Madang bird, but still more blackish above, with less and coarser white markings; the breast band is still less conspicuous; breast and abdomen are more broadly barred with black.

♀ ad.—Boboli, China Straits; August 19, 1922; A. F. Eichhorn.

Wing, 140; bill, 26; tarsus, 40.

Intermediate between *lacustris* and *reductus*. Agrees with *reductus* in the blackish back, the reduction of the breast band and the heavy black barring of the under parts; tends toward *lacustris* in the hair brown crown, by having the white bars of the upper back partly broken up in spots and by having the edges of the feathers of the back more olivaceous, less brownish. The upper tail-coverts are finely spotted with white. In general closer to *reductus*.

The other forms of *philippensis* in the Bismarck Archipelago will be discussed at a later occasion. I want to describe, however, at this time the form from the Solomon Islands, which I have found to differ from the known forms of this species.

Rallus philippensis christophori, new subspecies

TYPE.—No. 227845, Amer. Mus. Nat. Hist.; ♂ ad.; San Cristobal, Solomon Is. (1900 ft.); December 19, 1929; E. Mayr, W. F. Coultas and W. J. Eyerdam (Whitney South Sea Expedition).

Similar to *R. p. reductus*, with the breast band much reduced; black shaft streaks on crown narrow and inconspicuous; edge of feathers of crown hair brown; upper back less blackish, more tinged with brown; upper tail-coverts spotted with white, central tail-feathers with white bars; more heavily barred with black underneath; general coloration of upper parts rather variable.

Differs from *sethsmithi* Mathews (Fiji and New Hebrides) by having the upper back averaging more blackish and by having the under parts considerably darker; the unbarred area at the lower abdomen is reduced and the black bars on breast and flanks are very much broader than the white ones.

Wing, ♂ 150, ♀ 143, 142 + x; tail, ♂ 60, ♀ 57, 55 + x; bill, ♂ 30, ♀ 26.5, 27; tarsus, ♂ 44, ♀ 40, 40.

RANGE.—San Cristobal, Solomon Islands, and probably all of eastern Solomon Islands.

A single male from Santa Anna (Awa Raha) agrees with the three birds from San Cristobal, except that it is slightly larger, that it has no indication whatsoever of the breast band and that it is darker and more heavily barred underneath. The back has rather less black than in *christophori.*

The species has also been recorded from other islands in the eastern Solomon Islands: Ugi, Guadalcanar and Florida. I have not seen any material from these islands to be able to determine whether or not they belong to *christophori.* The close similarity with *sethsmithi* indicates that this form has reached the Solomon Islands from the east or southeast.

RALLICULA SCHLEGEL

The classification of the forms of this genus was until recently considered very simple. Two species were distinguished, *leucospila,* restricted to the mountains of the Vogelkop (Arfak and Wondiwoi), and *rubra,* comprising all the other forms. This arrangement was no longer acceptable, after Stein had discovered that two of the forms which were included in *rubra, klossi* and *forbesi,* occurred together in the Weyland Mts. Lord Rothschild (1936, Mitt. Zool. Mus. Berlin, XXI, pp. 238–240) who revised the genus to devise a more satisfactory arrangement found that all the forms could be arranged in two groups. *R. rubra* (with *klossi*) had small size and unbarred upper and under tail-coverts. All the other forms were of large size and had barred upper and under tail-coverts. These latter forms represent each other geographically and were therefore considered by him to belong to one species, which he called *leucospila* after the first named form.

I agree with Rothschild in the division of the genus in two groups and in considering *mayri* and *forbesi* to be more closely related to *leucospila* than to *rubra,* but I do not agree with him in making these two forms subspecies of *leucospila.* The three forms *leucospila, forbesi* and *mayri* might be considered as belonging to one "*Artenkreis*" (superspecies), but they are too different, particularly the males, to be regarded as subspecies.

The adult male of *leucospila* has upper back, scapulars and upper wing-coverts black with white longitudinal shaft streaks; the adult male of *forbesi* has the upper back rufous, and scapulars and upper wing-coverts solid black; and the adult male of *mayri* is rufous throughout without any black or white. It may be possible that the gap between *forbesi* and *leucospila* will be bridged by the discovery of the male of *steini*, since the female of *steini* differs from *forbesi* in the direction of *leucospila*, but the very isolated *mayri* will always have to be kept as a species. Particularly remarkable in this species is the similarity of the male with that of *rubra*, which had led Hartert to describe it as a form of *rubra*.

A key of all the forms has been published by Rothschild (*loc. cit.*).

Rallicula rubra rubra Schlegel

This race is restricted to the Arfak Mts. where it is probably much more common than the few specimens in collections indicate. Measurements are quoted under *klossi* (see below). It is rather doubtful whether the female of this race is yet known. Salvadori does not describe it and there is no specimen either in the Rothschild Collection or in the Leiden Museum. A specimen from the Arfak Mts. in the British Museum, labeled *rubra*, might be the female of *rubra*, since the tail is pure rufous, the upper and under wing-coverts are unbarred and the culmen is long. On the other hand, it is a very large bird (wing 106, tail 74) and the feathers of upper back, scapulars and upper wing are striped with longitudinal ochraceous stripes, both characters suggesting *leucospila*. More material of both *leucospila* and *rubra* must be collected before this specimen can be placed correctly.

Rallicula rubra klossi Ogilvie-Grant

Rallicula klossi Ogilvie-Grant (1913, Bull. Brit. Orn. Club, XXXI, p. 104) was compared in its original description only with *forbesi*, with which it, of course, has nothing to do. It was therefore for a long time considered a synonym of typical *rubra* until I showed in 1931 (Mitt. Zool. Mus. Berlin, XVII, p. 709) that it seemed to differ from *rubra* by the purer rufous-red, less blackish coloration of nape and upper back. Lord Rothschild (1936, Mitt. Zool. Mus. Berlin, XXI, p. 240) found as additional differences the smaller size of *klossi* and the reduction of the white bars on the under wing, although they are never quite absent as Junge (1937, Nova Guinea, N. S. I., p. 144) points out correctly.

The difference in size is not very striking.

Four males of *rubra* (2 New York, 2 Leiden) measure: Wing, 95, 98, 100, 102.5; tail, 64, 66, 67, 70; tarsus, 38, 38, 39, 39; and culmen, 30, 30, 31, 31.

A series of male *klossi* (New York) measures: Wing, 89–93 (91.7); tail, 50–59 (54.7); tarsus, 35–37; culmen, 28–30.

Up to the present time *R. r. klossi* is known from the Weyland Mts.

(see Rothschild, *loc. cit.*), from the Nassau Range (Ibis, 1915, Suppl. II, p. 290) and from the Orange Range (see Junge, *loc. cit.*).

Rallicula leucospila (Salvadori)

The characters of this species are sufficiently well known to make any additional description unnecessary.

Four males measure: Wing, 106, 108, 109, 111; tail, 65, 68, 69, 71; tarsus, 35, 36, 36, 39; culmen, 26, 28, 28; one female, wing, 107, tail, 61; tarsus, 31; culmen, 27.

The single male collected by me in the Wondiwoi Mts. at 1200 m. agrees very well with two males from the Arfak Mts. except that the rufous of the nape seems to extend farther on the upper back. This is possibly due to a different preparation of the specimen.

Rallicula forbesi steini Rothschild

Rallicula leucospila steini Rothschild, 1936, Mitt. Zool. Mus. Berlin, XXI, p. 239 —Kunupi (1500 m.), Weyland Mts.

This race, known from a single female, differs from *forbesi*, according to the original description, by the "brown-black, not brown-red" coloration of lower back and rump. The specimens of *forbesi* in the Rothschild Collection, with which *steini* was compared, were, however, old and foxed. The difference is practically non-existing in fresh skins. *R. f. steini* seems to differ from the female of *forbesi* (as indicated by Rothschild in the key) by having the spots on the upper back pure white, instead of buff, and by having the scapulars, upper wing-coverts and tertials marked much more coarsely with broad streaks of buff. The tail shows very little barring.

Wing, 107; tail, 62; tarsus, 37; culmen, 29.

This bird has a much lower vertical distribution than *R. rubra klossi* (above 1800 m.).

Rallicula mayri Hartert

Wing, ♂ 111, 115, 116, 117, ♀ 110; tail, ♂ 63, 69, 70, 72, ♀ 65; tarsus, ♂ 37, 37, 38, ♀ 36; culmen, ♂ 27, 28.5, 28.5, ♀ 26; weight (in gr.), ♂ 123, 123, 129, ♀ 119.

This is a large bird. It agrees in size with the largest examples of *Rallicula f. forbesi*, but is considerably larger than *R. f. dryas* Mayr. The males of *dryas* weigh 78–106 (av. 88.4) g., and the females 65–96 (av. 82). The males of *mayri* are therefore 42 per cent heavier, the females 45 per cent heavier than those of *dryas*.

This species, isolated on the Cyclop Mts., has an exceedingly small range.

Amaurornis olivaceus moluccanus (Wallace)

In 1879, Schlegel described, apparently on the basis of an immature specimen, a new form from the Vogelkop which he named *frankii*. This form was considered a synonym of *moluccanus* by most authors, but Hartert stated in a recent paper (1930, Novit. Zool., XXXVI, p. 124) that New Guinea birds seem to be "darker gray on the underside, and a shade darker olive on the back" than birds from the Moluccas. I have insufficient material (1 ♂, 2 ♀ from the Moluccas, and 2 ♂, 4 ♀ from New Guinea), but I fail to see any constant difference between the two series. One of the New Guinea males (from Ifar) has the lower belly and crissum very dark, but a male from Batjan is also rather dark and a male from southeast New Guinea is rather light. Females are in general much lighter on lower belly and under tail-coverts. The only difference I can find in regard to the upper parts is that the fresh skins (collected during the last 10 years) are much darker and less brownish than the old skins (collected 40 years ago or longer). I therefore consider *frankii* a synonym of *moluccanus*.

I am quite at a loss to understand how van Oort (1907, Notes Leyden Mus., XXIX, p. 172) and Siebers (1930, Treubia, Suppl., Fauna Burnana, I, p. 64) can maintain that *moluccanus* and *frankii* are different species. My measurements do not bear out their conclusions at all:

A. o. moluccanus.—MOLUCCAS: wing, ♂ 145, ♀ 136, 143; culmen, ♂ 35, ♀ 30; tarsus, ♂ 53, ♀ 49, 51. NEW GUINEA: wing, ♂ 156, 158, ♀ 135, 137, 142, 142; culmen, ♂ 34, 34, ♀ 29, 31, 31, 31; tarsus, ♂ 49, 50, ♀ 47, 49, 50.

The geographical variation that occurs within *nigrifrons* in the Bismarck Archipelago and in the Solomon Islands will be described at another occasion.

PORPHYRIO BRISSON

Only a decade or two ago the forms of this genus were divided into a great many species. Slowly they were combined with each other, as our knowledge of the genus grew and as intermediate forms were discovered. Hartert in his review in 1924 (Novit. Zool., XXXI, pp. 105–108) still kept *melanotus* specifically separated from *poliocephalus*, but Peters (1934, Check-list, II, p. 208) unites them in one species. The fact that this species combines such widely differing forms as *poliocephalus*, *ellioti*, *bellus* and *fletcherae* immediately suggests to draw the specific lines still wider and to include also *porphyrio*, *madagascariensis* and *pulverulentus* in the same species. These species are hardly more different from each other than the various forms of "*poliocephalus*" (sensu Peters) and not more different than a great many island forms which have been unhesitatingly combined in one species by all recent authors. H. v. Boetticher (1935, Folia Zool. Hydrobiol., VIII, p. 47) proposes to accept such a large species, a conclusion at which I had arrived independently. There is no reliable evidence that the ranges of any of the forms ever overlapped, as had been maintained by some of the older authors for *porphyrio* and *madagascariensis.*

The use of the specific name *porphyrio* for the eastern forms will prevent the adoption of *albus* as the specific name of the forms combined by Peters under the name *poliocephalus.* The name *albus* White, which was given to the white phase of the Lord Howe Island race, antedates *poliocephalus* by 11 years. Peters circumvented this difficulty, to which I had called attention in an earlier paper (1931, Amer. Mus. Novit., No. 486, p. 8), by giving *albus* specific rank. He gives no reason for this action, which is quite untenable in view of the known facts. White phases (mutants) occur in several races from the islands east of Australia; in fact, the type specimen of the New Zealand race *stanleyi* is such an albino. Nobody has yet proposed to restrict the name *stanleyi* to the white individuals, and to give another name to the normal colored birds of the New Zealand race! In the case of the Lord Howe population of *Porphyrio,* it is known that both normally colored and white birds occurred on the island, as well as partly blue and partly white intermediates. There is no other alternative than to use the name *albus* for the Lord Howe Island race. A study of the normally colored specimens, of which there are, I believe, some in the Sydney museum, should reveal the true characters of this race.

I have been collecting notes on the genus *Porphyrio* for the last eight years and have examined the material of most of the European museums. In spite of this, I am not yet ready to write the long needed revision of the eastern forms of the genus, since I am expecting more material from several localities which are so far only weakly represented in our collections. One phenomenon occurs over a considerable part of the eastern range of *Porphyrio* which has prevented a better understanding of the forms, namely, the presence of two color phases. Typical *indicus* from the Greater Sunda Is. always have a bright blue breast shield (or better, throat patch) and typical *melanotus* always have the entire under parts of a uniform purplish blue. Both types of plumage occur, however, on most of the islands between the ranges of *indicus* and *melanotus.* Hartert has called attention to this in his review (*op. cit.*, p. 107), but I do not agree with his interpretation. He believes that only the birds with the blue breast patch are the resident birds and that the birds with the plain under parts are migrant *melanotus*. This conclusion was accepted by several subsequent workers as, for example, by Siebers in his work on the birds of Buru (1930, Fauna Buruana, I, 3, p. 66–67). It is, however, not supported by any facts. Not only is there no evidence for any extensive migratory movements of *P. p. melanotus*, but the "*melanotus*" of the Moluccas and the New Guinea region are as small as the resident *melanopterus*. Six "plain breasted" birds from the Moluccas that I have examined have a wing-length of 223, 242, 246, 248, 250, 257, against 265–281 in Australian *melanotus*. Equally convincing is the fact that about a third of the birds which were collected in the Moluccas and in the New Guinea region, represent an intermediate condition. The result is, of course, an enormous variability, and it is evident that no revision of these birds will be conclusive which is not based on adequate series. Such are, up to the present, not yet available from most localities, where this rather secretive swamp bird occurs.

CHARADRIIDAE

The Papuan *Charadrius dubius*

The little plovers of the Papuan region have been listed as *jerdoni* for more than fifty years. It was rather improbable that the Indian bird and the Papuan bird should be the same, since there is a considerable gap (Borneo to New Guinea) between the two populations. However, the few specimens available to most students revealed no significant differences either in measurements or coloration (see Hartert, Vög. pal. Fauna, II, p. 1537). A new examination of considerable material showed that the two populations are clearly separable by the coloration of the tail, a character mentioned by Ramsay, as long ago as 1879 (Proc. Linn. Soc. New South Wales, IV, p. 93). I want to acknowledge gratefully the loan of a fine series of Indian *jerdoni* by the authorities of the British Museum.

Charadrius dubius papuanus, new subspecies

TYPE.—No. 736592, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Upper Setekwa River, Sept. 13, 1910; A. S. Meek.

Similar to *Ch. d. jerdoni* Legge, but bill averaging longer; outermost tail-feather entirely white (6 adults) or just with a vaguely indicated brownish spot (3 adults) while there is a conspicuous bar in *jerdoni;* the brown on the other tail-feathers equally reduced; apparently more yellow on the lower mandible, even the upper mandible often with yellow; behind the black bar across the crown there is a narrow white bar, which in *jerdoni* is less distinct or missing.

Wing, 6 ♂ ad., 105–108 (106.4), 4 ♀ ad., 106, 110, 114.5; culmen, 6 ♂ ad., 14 (in all 6), 4 ♀ ad., 13, 14, 14.5, 15.

Specimens examined: 1 ♀, 1 imm., Astrolabe Bay; 1 ♂, Orangerie Bay; 1 ♂, Galley Reach; 2 ♂, upper Setekwa River; 1 ♀, Ifar, Sentani Lake; 2 ♂, 2 ♀, New Ireland. Compared with 19 adults from India and 2 adults from Borneo. Borneo birds have the broad tail-bar of *jerdoni.*

The wings of Indian birds measure: 105, 106, 107, 107, 107, 107.5, 109, 110, 110, 110, 110, 111, 111, 112, 113, 113, 114, 115; culmen, 12–14 (av. 12.6).

Lobibyx miles (Boddaert)

Peters accepts (Check-list II (1934), p. 239) Mathews' division of this species in two races, one (*personatus* Gould) for the Australian birds, and one (*miles*) for the birds from New Guinea, the Moluccas, etc. I have compared 11 Australian specimens with 17 birds from the islands and I have been unable to find the slightest difference of size or coloration. The type of *harterti* (from Inkerman, Queensland) has a wing of 236, which is slightly longer than that of any other Australian specimen examined by me,, but culmen and tarsus measurements fall well within the range of other Australian birds, and a male from Tepa, Babber Is., has a wing, which is even longer (237 mm.). It is obvious that *personatus* and *harterti* are synonymous of *miles.*

RECURVIROSTRIDAE

Himantopus himantopus leucocephalus Gould

Mathews separated two races from the east Australian *leucocephalus,* one to include the birds from northwestern Australia (*assimilis*) and one for the birds of Timor and Celebes (*timorensis*), both based on supposedly smaller size. No characters are given by which *assimilis* could be separated from *timorensis;* in fact, almost identical measurements are given for both forms. I have measured 17 specimens from the Moluccas and Lesser Sunda Islands, 11 birds from northwestern Australia, and 8 birds from eastern Australia, and I have been unable to find any differences of subspecific value. In fact, a male from Celebes (tarsus 126) and one from Derby, northwestern Australia (tarsus 131), have longer tarsi than the largest bird from eastern Australia (124). The wings measure as follows: males, island range, 224, 231, 232, 236, 236, 239, 240, northwestern Australia, 224, 228, 229, 235, eastern Australia (South Australia, Victoria, New South Wales), 233, 235, 236, 242. Tarsus, males, island range, 106, 111, 115, 116, 118, 120, 121, 123, 126, northwestern Australia, 114, 118, 122, 131, eastern Australia, 106, 115, 119, 124. There are no color differences between birds from the various localities and the quoted measurements show clearly that neither *timorensis* nor *assimilis* can be maintained.

There are no definite breeding records of this species from the New Guinea region, so far as I know, but the Whitney South Sea Expedition (H. Hamlin) collected some specimens on Fergusson Island in January, during the Australian breeding seasons, and the gonads were recorded as "large" on the labels. It is, however, doubtful whether all the birds that were collected outside of Australia are really resident of those regions. There is some evidence for migratory movements and for the sudden appearance of a flock of birds on a locality where they had never been seen before. It is probable that such birds are winter visitors from Australia.

BURHINIDAE

Esacus magnirostris (Vieillot)

In the years 1912 and 1913 Mathews described 3 Australian subspecies of this species, all of which are clear synonyms of *magnirostris*. In 1920, Oberholser (Proc. U. S. Nat. Museum, LV, p. 133) described a form from the China Sea, as *scommophorus*, to include all the birds of the East Indies. The new race is said to have "upper and lower parts paler" than Australian birds. I have compared a large series of specimens from the Sunda Islands, the Philippines, Moluccas, the Papuan region and Australia and fail to see any differences in coloration. Fresh birds are dark, but worn and bleached birds are pale. Neither are there any differences in size between Australian and Malaysian birds, as my own measurements and those of A. Meinertzhagen (Ibis, 1924, p. 354) show. Birds from the Andaman Islands, although I cannot see any color differences, average very slightly smaller than birds from the rest of the range. Although I consider the difference much too slight to be of subspecific value, I want to point out (against the opinion of A. Meinertzhagen) that Oberholser's name is NOT available for this population, since birds from Malaysia are large, as is shown by the measurements of the type of *scommophorus* and by my own measurements.

The generic name *Orthorhamphus*, based on the slight difference in the shape of the bill, is quite untenable, as has been pointed out by several authors. In fact, the two species *recurvirostris* and *magnirostris* are so similar that one is strongly tempted to unite them into one. They certainly form one superspecies. *E. magnirostris* is a bird of coral reefs and sea beaches, while *E. recurvirostris* is primarily a river bird. This difference of habitat induces apparently different feeding habits and this in turn is correlated with the shape of the bill, as has already been suggested by Rensch (1931, Mitt. Zool. Mus. Berlin, XVII, pp. 495–496).

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NEW SPECIES OF MALLOPHAGA FROM *AFROPAVO CONGENSIS* CHAPIN

By Theresa Clay

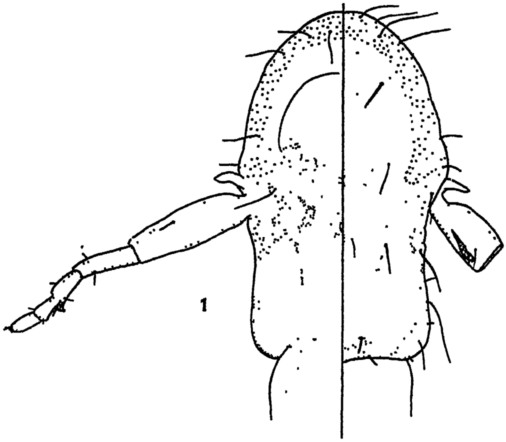
Through the kindness of The American Museum of Natural History and of Dr. Schouteden of the Belgian Congo Museum, Tervueren, the author has been able to examine specimens of Mallophaga collected from *Afropavo congensis*, the remarkable gallinaceous bird recently discovered and described by Dr. Chapin. There are eight species represented in the material examined, four belonging to the superfamily Ischnocera and four to the superfamily Amblycera. In the present paper only the ischnoceran species are considered since species of amblyceran Mallophaga from gallinaceous birds cannot be described satisfactorily without a complete revision of the existing genera and species. The author hopes to undertake this revision shortly and will then be in a position to describe the remaining species from *Afropavo congensis*.

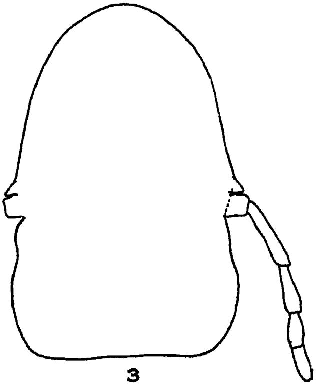
The species described below are assignable to two genera, *Lipeurus* and *Goniodes*, and as would be expected from the host these species are not closely related to any of the known species from gallinaceous birds. In a paper shortly to be published the author has shown that the *Lipeurus* species from gallinaceous birds fall into three genera (excluding *Lagopoecus*), examples of which may be found on one host. Within the genus true *Lipeurus* [genotype *L. caponis* (Linné)] there are a number of groups of closely related species, among which is one containing species from the following genera of Phasianidae: *Gennaeus*, *Gallus*, *Phasianus*, *Chrysolophus*, *Rheinardia* and *Rhizothera;* the species from *Pavo cristatus* (description in the press) although resembling this group differs in certain important characters; species from *Numida*, *Acryllium*, *Phasidus* and *Agelastes* form another and quite distinct group. The *Lipeurus* from *Afropavo* is typical of the first-mentioned group containing species from *Gennaeus* and *Gallus*.

The larger *Goniodes* from *Afropavo*, *G. wilsoni*, has no close affinities with the *Goniodes* from such Phasianidae as *Gallus*, *Phasianus* and *Gennaeus*, nor with the typical and distinct species, *G. pavonis* (Linné) from *Pavo cristatus*. A distinct species from *G. pavonis* also from *Pavo* *cristatus* (to be described shortly) has the terminal segment of the male abdomen similar to that of *G. wilsoni*. However, it is apparent from a comparison of this species from *Afropavo* with all other known species from gallinaceous birds that it resembles most nearly an unnamed species of *Goniodes* from *Guttera plumifera* (correct identity of host doubtful). *G. wilsoni* has the following characters in common with this unnamed species: the general shape of the head; large thickened trabeculae overhanging the antennae; antennae without greatly enlarged first segment; a large number of hairs on the head and thorax; general characters of the abdomen especially in the presence of dorsal clumps of hairs each side of the mid-line of certain segments and the form of the terminal segment; paramera of male genitalia unequal in length. The females of these two species also resemble each other in the form of the head, trabeculae, chaetotaxy of head, thorax and abdomen. In both the male and the female, *G. wilsoni* differs from the other species in the form of the pleurites and in the absence of intertergital thickening.

The remaining two species, *Goniodes chapini* and *G. afropavo*, which are almost certainly closely related to each other, have apparently no near affinities with any of the known *Goniodes*. Superficially these two species recall *G. curvicornis* Giebel from *Argusianus argus* and an unnamed species from *Rheinardia o. ocellata*, but at the present state of our knowledge of the genus *Goniodes* it cannot accurately be said that their true affinities lie with the latter species. These two species, *G. chapini* and *G. afropavo*, are also of interest as an example of the occurrence of two closely related species on the same host in which the females differ but slightly from each other while the two males exhibit a greater degree of difference. In the present case it has not been possible to settle with complete certainty to which males the respective females belong as all the specimens where collected from one host and the differential characters of the males of the two species are the presence of secondary sexual characters in *G. chapini*, i.e., modified antennae, trabeculae and shape of head, and the form of the male genitalia; these characters cannot therefore be used to separate the two females. The differential characters which have been used in the case of the females are the shape of the trabeculae and the size and shape of the abdomen.

It is unwise in the present state of our knowledge of Mallophaga, with so many problematic unknown species, to draw any conclusions from the mallophagan species as to the relationships of the avian host species and genera within a family, but it is of interest to note that the





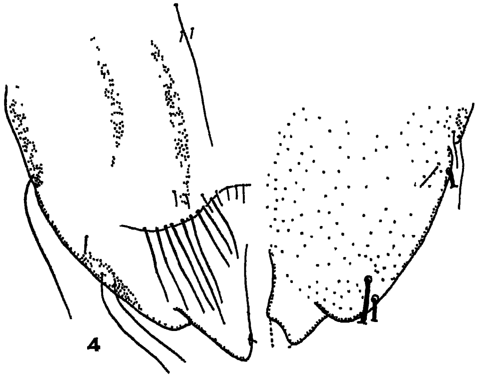


Fig. 1. *Lipeurus schoutedeni*, head of ♂.
Fig. 2. *Lipeurus schoutedeni*, genitalia of ♂.
Fig. 3. *Lipeurus schoutedeni*, head of ♀.
Fig. 4. *Lipeurus schoutedeni*, terminal segments of ♀ abdomen.

Mallophaga parasitic on *Afropavo* are not closely related to any of the known species and that their affinities are found both with species from the Phasianinae and the Numididae. Thus *Lipeurus schoutedeni* has its affinities with species from the *Gennaeus, Gallus, Phasianus* group; while the affinities of *Goniodes wilsoni* lie with species from *Guttera; G. chapini* and *G. afropavo* on the other hand seem to have no close affinities with any known species. It is possible to suggest, therefore, from a consideration of the mallophagan evidence that *Afropavo* may form the link between the Phasianinae and the Numididae.

Lipeurus schoutedeni, new species

Figures 1 to 4

This species is distinguished from *Lipeurus caponis* (Linné) by the long, narrow head in both sexes and in the male by the presence of 2 pre-antennal and 2 post-antennal spinelike hairs and by the shape of the basal plate and in the female by the characters of the terminal segments.

Description of Male.—Head (Fig. 1) with occipital bands present and with first segment of antenna enlarged and bearing a short thickened process and third segment with thickened free distal end.

Prothorax with straight lateral and posterior margins, the latter bearing a short hair each side. Meso-metathorax showing lateral indication of meso-metathoracic junction; posterior margin shallowly convex and bearing a postero-lateral hair and spine, a clump of 1 short and 3 long hairs and a single shorter hair each side of midline.

Abdomen with general characters and chaetotaxy as in *Lipeurus caponis;* pleurites narrow and posterior margin of terminal segment rounded.

Male genitalia with general characters as shown in figure 2 (material inadequate for detailed figure).

Description of Female.—Shape of head as shown in figure 3. Chaetotaxy of head as in the male but the 4 dorsal spinelike hairs are replaced by shorter and finer hairs and the dorsal hair at the upper level of the mandible is absent.

Thorax as in the male but broader.

Abdomen with general characters and chaetotaxy as in *L. caponis* with the exception of the terminal segments (Fig. 4).

Measurements

	Male		Female	
	Length	Breadth	Length	Breadth
Head	0.68 mm.	[a]0.42 mm. [b]0.35	0.70 mm.	[a]0.44 mm. [b]0.46
Prothorax	0.20	0.29	0.19	0.32
Meso-metathorax	0.34	0.43	0.37	0.49
Abdomen	1.78	0.47	1.82	0.60
Total	2.96		3.01	
C.I. [a]	....	0.62	....	0.63
[b]	....	0.51	....	0.66

Head[a] is greatest pre-antennal breadth.
Head[b] is greatest post-antennal breadth.
C.I. is head index (breadth:length).

Material Examined.—1 ♂, 4 ♀, from *Afropavo congensis* from E. Congo Forest, collected July, 1937.

Holotype.—♂ in The American Museum of Natural History.

Goniodes wilsoni, new species

Figures 5 to 9

The relationships of this species and its differential characters have been discussed above.

Description of Male.—Head (Fig. 5) with large overhanging trabeculae and with numerous dorsal hairs; antenna with first segment not greatly enlarged and third produced into a somewhat transparent forwardly directed projection running parallel to the fourth segment.

Thorax as shown in figure 5.

Abdomen widest at segment III and with segment I large, segment VIII reduced and segment IX narrowed and rounded posteriorly. Pleurites distinct and broad; tergal plates I–VIII interrupted medianly and sternal thickening in the form of small lateral segmental plates each side of mid-line.

Chaetotaxy of the Abdomen.—Lateral and dorso-lateral hairs on the posterior margin of segment I, 18–20 in number; on segment II, 10–14; segment III, 7–10; segment IV, 8–10; segment V, 10–12; segment VI, 6–8; segment VII, 5–8; segment VIII, 4–6. On the dorsal surface segment I has 18 hairs each side of the mid-line; segment II has 22–26 each side; segment III has 28–30 of which the central 18 each side are thicker and form a clump of hairs situated at the inner end of the tergal plate; segment IV has 29 hairs each side with the central 15 each side thicker and forming a clump as in segment III; segments V–IX as shown in figure 6. On the ventral surface segments I–IV with a central hair each side of mid-line; segments V–VI with 2 central hairs each side; segments VII–IX as shown in figure 6; all segments also bear a varying number of minute spines on the ventral surface.

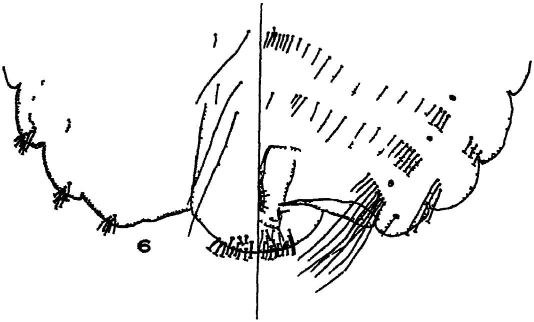
Male genitalia with greatly lengthened basal plate and with one paramera shorter and narrower than the other (Fig. 7).

Description of Female.—Head (Fig. 8) with dorsal hairs less numerous than in the male; anterior margin with 4 short marginal hairs each side; 1 sub-marginal hair, 1 in upper part of pre-antennal region and 1 in post-antennal region opposite each eye; number of marginal hairs on the temple as in male, but of the 10 hairs only 7 are long.

Thorax as in the male but with only 4 lateral and no posterior hairs on the prothorax and with 9–11 lateral and 3 posterior marginal hairs each side of pterothorax.

Abdomen of considerably greater size than that of male; segment I with postero-lateral corner produced into a sharp point each side. Tergal plates I–VII separated medianly; sternal plates as in male; terminal segments as shown in figure 9.

Chaetotaxy of the Abdomen.—Lateral and dorso-lateral hairs on the posterior margin of segment I, 2–3 in number each side; segment II has 6–9 each side; segment III has 8 each side; segment IV has 8–9 each side; segment V has 10 each side; remaining segments as shown in figure 9. On the dorsal surface segment I has 5 hairs each side; segment II has 10 hairs; segment III has 7–9 hairs; segment IV has 7 hairs; segment V has 4 hairs; remaining segments as shown in figure 9. On the ventral surface segments I–III have 1 central hair each side; segments IV–VI have 2 central hairs each side; segment VII has 1 central hair and a number of minute spines each side; terminal segment as shown in figure 9.



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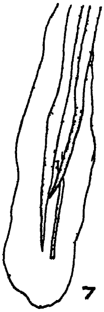

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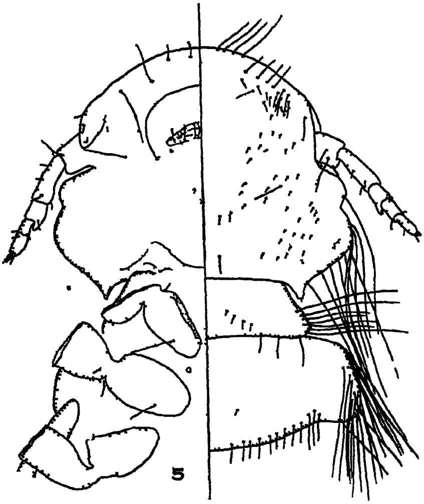

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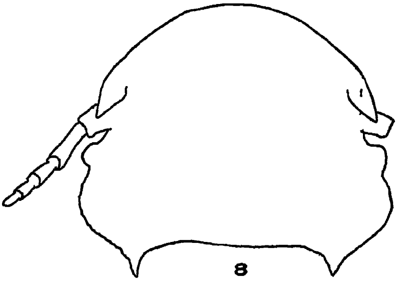

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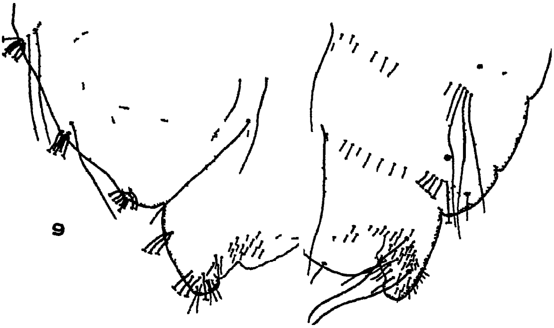

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Fig. 5. *Goniodes wilsoni*, head and thorax of ♂.
Fig. 6. *Goniodes wilsoni*, terminal segments of ♂ abdomen.
Fig. 7. *Goniodes wilsoni*, distal end of ♂ genitalia.
Fig. 8. *Goniodes wilsoni*, head of ♀.
Fig. 9. *Goniodes wilsoni*, terminal segments of ♀ abdomen.

Measurements

	MALE		FEMALE	
	Length	Breadth	Length	Breadth
Head	0.92 mm.[1]	1.13 mm.	1.09 mm.	1.28 mm.
Prothorax	0.35	0.78	0.36	0.89
Pterothorax	0.46	1.16	0.49	1.32
Abdomen	1.69	1.70	2.96	2.04
Total	3.12		4.66	

MATERIAL EXAMINED.—12♂, 16♀, from *Afropavo congensis*, from the E. Congo Forest, collected July, 1937.

HOLOTYPE.—♂ in the Belgian Congo Museum, Tervueren.

Named in honor of Rev. T. H. Wilson of Inkongo, Sonkuru District, who collected the specimens.

Goniodes chapini, new species

Figures 10 to 13

This species is unlike any hitherto recorded and resembles most nearly *G. afropavo* from the same host. It is distinguished from this latter species in the male by the shape of the head and by the form of the trabeculae, antennae and genitalia and in the female by the shape of the trabeculae and chaetotaxy of the terminal segments of the abdomen.

DESCRIPTION OF MALE.—Head (Fig. 10) with short blunt-ended trabeculae; antennae of unusual form with all segments enlarged and with segments I–III differing but little in length and width, and segment V rounded and somewhat globular distally.

Thorax as shown in figure 10.

Abdomen short and rounded, broadest at the third segment and with segment I large; segment VIII greatly reduced and segment IX narrow and rounded posteriorly. Tergal plates I–VIII separated medianly; sternal thickening in the form of small lateral segmental plates each side of mid-line. Segments I–VI showing lateral internal circular structures not found elsewhere among the *Goniodes*.

CHAETOTAXY OF THE ABDOMEN.—On the dorsal surface segments I–II have 3 central hairs and 1 post-spiracular hair each side (those on segment I being in an equivalent position to the post-spiracular hairs of the other segments); segments III–V have 2 central hairs and a post-spiracular hair each side; segments VI–IX as shown in figure 11. On the ventral surface segments I–II have a central hair each side of the mid-line; segments III–IV have a central and a stout lateral hair each side; segments V–IX as shown in figure 11. Segment I has no postero-lateral hairs; segments II–VI have 1 postero-lateral hair each side.

Genitalia with general characters as shown in figure 11 (material inadequate for detailed figure).

DESCRIPTION OF FEMALE.—Shape of head as shown in figure 12, with chaetotaxy as in the male but with the anterior marginal hairs shorter.

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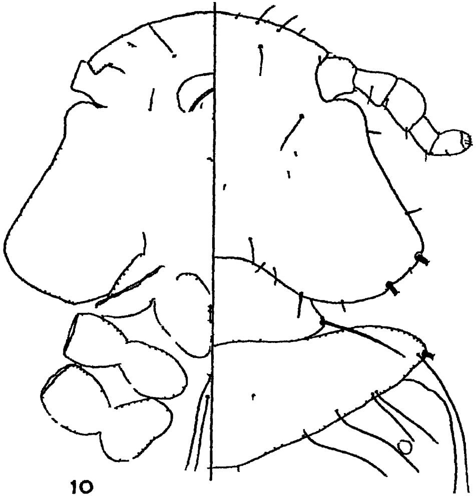
[1] Length measurement of heads taken along the median line; i.e, backward projections of temples are not included.



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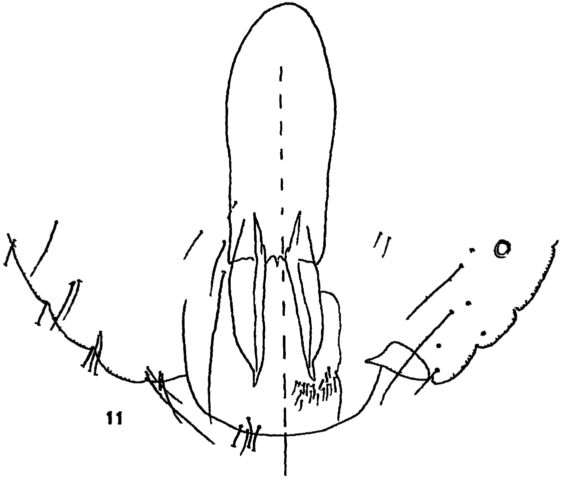

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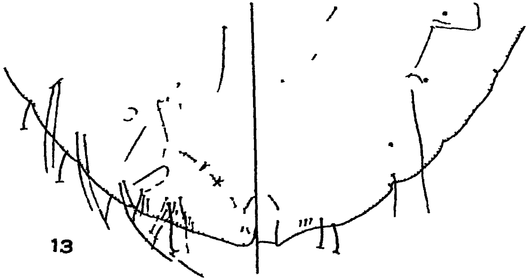

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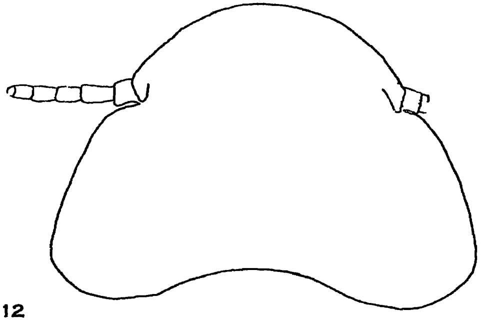

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Thorax as in the male but there are 2 not 4 postero-lateral hairs each side of the pterothorax.

Abdomen rounded but somewhat more elongated than in the male with tergal plates I–VII separated medianly and sternal plates arranged as in the male.

CHAETOTAXY OF THE ABDOMEN.—On the dorsal surface segments I–VII with a central and a post-spiracular hair each side of the mid-line (in all the specimens examined, on segments I–IV only the clear "pustule" of the post-spiracular hairs are present, there being no hair attached); terminal segments as shown in figure 13. On the ventral surface segments I–II have a central hair each side of mid-line; segments III–IV have a central hair and a lateral hair each side; segment V has 2 central and 2 lateral hairs each side; terminal segments as shown in figure 13. Postero-lateral hairs as in male.

Measurements

	MALE		FEMALE	
	Length	Breadth	Length	Breadth
Head	0.36 mm.	0.60 mm.	0.42 mm.	0.66 mm.
Prothorax	0.15	0.35	0.17	0.36
Pterothorax	0.19	0.64	0.22	0.65
Abdomen	0.71	0.84	0.84	0.85
Total	1.26		1.38	

MATERIAL EXAMINED.—1 ♂, 5 ♀ from *Afropavo congensis* from E. Congo Forest collected in July, 1937.

HOLOTYPE.—♂ in The American Museum of Natural History.

Goniodes afropavo, new species

Figures 14 to 17

This species resembles most closely *G. chapini* from which it may be distinguished by the characters of the head and abdomen as given above under that species.

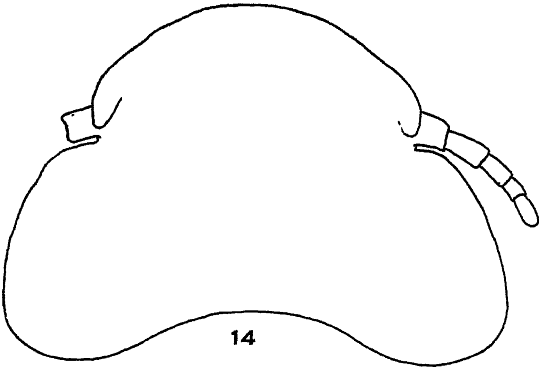
DESCRIPTION OF MALE.—Head (Fig. 14) with trabeculae longer and more pointed than in *G. Chapini;* antennae filiform and unmodified; chaetotaxy as in *G. Chapini.*

Thorax with shape and chaetotaxy as in the female of *G. chapini.*

Abdomen similar to that of *G. chapini* but more elongated in shape; abdominal sclerites as in *G. chapini.*

CHAETOTAXY OF THE ABDOMEN.—On the dorsal surface segments I–II have 2 central hairs and 1 post-spiracular hair each side; segments III–V have 2 central hairs and 1 or 2 post-spiracular hairs each side, the outer of the central hairs are longer and stouter than in *G. chapini;* segments VI–VIII as in *G. chapini;* segment IX with 13–15 inner hairs. On the ventral surface segment I–II has a central hair each side of the mid-line; segment V has 2 central hairs and 2 lateral hairs each side; segment VI has a central hair and 2 lateral hairs each side; segment VII has a central hair and 4 lateral hairs each side; segment VIII has 6 lateral hairs each side; segment IX has three sub-marginal hairs each side. Postero-lateral hairs as in *G. chapini.*

Genitalia as shown in figure 15.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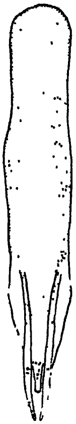
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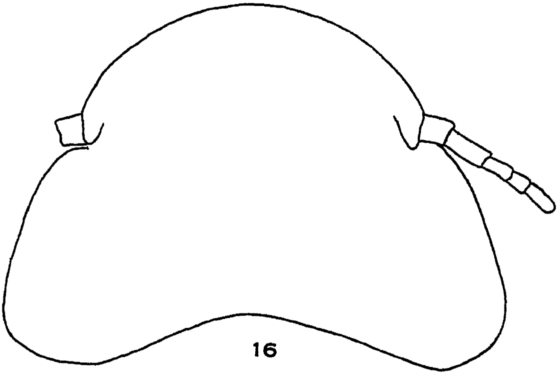
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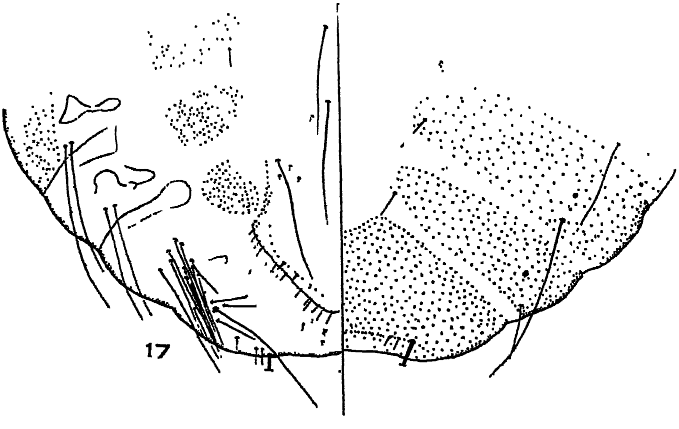
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Fig. 14. *Goniodes afropavo*, head of ♂.
Fig. 15. *Goniodes afropavo*, genitalia of ♂.
Fig. 16. *Goniodes afropavo*, head of ♀.
Fig. 17. *Goniodes afropavo*, terminal segments of ♀ abdomen.

Description of Female.—Shape of head as shown in figure 16, with chaetotaxy as in *G. chapini*.

Thorax as in the male.

Abdomen more elongated than in *G. chapini* but otherwise similar except for the chaetotaxy of the terminal segments (Fig. 17).

Measurements

	Male		Female	
	Length	Breadth	Length	Breadth
Head	0.41 mm.	0.67 mm.	0.42 mm.	0.67 mm.
Prothorax	0.15	0.37	0.16	0.37
Pterothorax	0.21	0.67	0.22	0.67
Abdomen	0.76	0.86	0.91	0.85
Total	1.40		1.57	

Material Examined.—4♂, 7♀, from *Afropavo congensis* from E. Congo Forest collected in July, 1937.

Holotype.—♂ in The American Museum of Natural History.

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RECORDS AND DESCRIPTIONS OF AFRICAN SYRPHIDAE.— I (DIPTERA)

BY C. H. CURRAN

In 1915, Bezzi reviewed the Ethiopian Syrphidae contained in the collections of the British Museum but this work merely listed a large number of the species. Since that time there have been numerous descriptions of species new to the region and it is now a rather tedious task to identify material in the family. With a view to bringing keys to the species belonging to many of the genera up to date a series of papers dealing with the family is proposed. New records and descriptions of new forms are included along with the keys.

CERIOIDES RONDANI

Following is a key to the African species. Most of the forms are known from very few specimens.

TABLE OF SPECIES

1.—Wings with three brown spots along the costa; length about 8 mm...*divisa* Walker.
Wings differently colored...2.
2.—Antennae not situated on a pedicel.......................................3.
Antennae situated on a pedicel...4.
3.—Occiput blackish except a small spot on either side of the vertex...*bezzii* Hervé-Bazin.
Occiput yellow on the upper part behind the eyes............*marginalis* Bezzi.
4.—Scutellum yellow, the base sometimes blackish.........................5.
Scutellum black, often with yellow border or discal markings..............12.
5.—Pleura without yellow markings...6.
Pleura with yellow markings..7.
6.—Face wholly yellow, the cheeks somewhat reddish...............*rufifrons* Curran.
Face with a pair of gently curved median blackish vittae......*afra* Wiedemann.
7.—Face with one or more black or brownish vittae.........................8.
Face wholly yellow...*ugandana* Kertesz.
8.—Pleura with pale yellow stripe..9.
Pleura with reddish stripe..*neavei* Bezzi.
9.—Face with a dark median vitta and a stripe on either side below..*pulchra* Hervé-Bazin.
Face with one or two vittae..10.

10.—Face with a single median vitta..11.
Face with two brown vittae which meet above and below..*gambiana* Saunders.
11.—Abdomen very strongly pedicellate........................*hopei* Saunders.
Abdomen not pedicellate..............................*vespiformis* Latreille.
12.—Both the third and fourth abdominal segments with yellow posterior borders..13.
Usually both the third and fourth segments not yellow posteriorly, the third sometimes with reddish apex..14.
13.—Scutellum with a yellow fascia across the disc; abdomen scarcely constricted.. ....*aurata* Curran.
Scutellum with yellowish apical border; abdomen moderately constricted basally..................................*maculipennis* Hervé-Bazin.
14.—Face black or brown, with slender median vitta or spots, narrow stripes converging toward the oral margin, slender stripes separating the face and cheeks and spots or stripes opposite the antennae....................15.
Face much more extensively yellowish..................................17.
15.—Scutellum with a yellow border.......................................16.
Scutellum without yellow border......................*ammophilina* Speiser.
16.—All antennal segments of about equal length; posterior femora strongly narrowed on more than apical half..................*bequaerti*, new species.
Third antennal segment much shorter than the second; posterior femora of almost uniform thickness..............................*varipes* Curran.
17.—Legs black, the femora somewhat reddish basally.....*speiseri* Hervé-Bazin.
Legs mostly reddish..18.
18.—The brown costal border does not extend behind the third vein; face with median geminate brownish vitta widened in the middle.*congoensis* Bezzi.
The brown costal border extends well behind the third vein; face with a strong Λ-shaped black stripe..........................*brunneipennis* Loew.

Cerioides bezzii Hervé-Bazin

Hervé-Bazin, 1913, Rev. Zool. Afr., III, p. 87.

Male and female, Stanleyville, Congo, March, 1915.

Cerioides marginalis Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 142.

Male, Stanleyville, Congo, March, 1915.

This species was originally described as a variety of *bezzii* but the two forms are very distinct. The genitalia of the males are markedly different and the third and fourth sternites are longitudinally carinate in the middle in *marginalis*, quite plain in *bezzii;* the tarsi are wholly dark in *marginalis*, etc.

Cerioides bequaerti, new species

A large, blackish species, the wings pale brown with the costal border broadly dark brown. Length, about 22 mm.

Female.—Head brownish black, the cheeks and lower part of face castaneous.

Front and upper occiput with thin cinereous pollen, the frontal depression deep and arcuate. Lower part of occiput and middle of face thickly cinereous pollinose. Face rather strongly produced downward and with a strong tubercle below, separated from the cheeks by a narrow yellow line; a second broader yellow stripe extends from the upper facial orbits to the anterior oral margin on each side and there is a short reddish stripe extending over the tubercle. Antennal pedicel as long as the head, broadly reddish basally; antennae black, the third segment brown with yellow style.

Thorax black, rather thinly cinereous yellow pollinose, the dorsum covered with tiny tubercles, and with only indistinct hair. Posterior calli and propleura reddish; scutellum with the apical border yellow. Poststernum chitinized.

Legs black, the bases of the anterior four femora, their trochanters, knees and bases of the anterior four tarsi reddish; posterior femora swollen on basal third, slender on apical two-thirds.

Wings pale brownish, dark brown on the anterior third and in the posterior half of the second basal cell. Squamae dark brown; halteres reddish yellow.

Abdomen strongly pedicellate, the second segment long and narrow, gently widening from the base and strongly widening on the apical fifth; third segment widening from base to apex, the abdomen thence narrowing to the tip. First segment with transverse, basal yellow spots laterally; second with the base reddish, the third with the apex broadly reddish. Hair very short and black, appressed, reddish on the fourth segment; pollen thin, cinereous yellow; second segment with preapical band of opaque black.

HOLOTYPE.—Female, Stanleyville, Congo, March, 1915 (J. Bequaert).

Cerioides vespiformis Latreille

Ceria vespiformis LATREILLE, 1809, 'Gen. crust. ins.,' IV, p. 328.

Male and three females, Amizoniz, Morocco (T. D. A. Cockerell).

These specimens are all somewhat differently marked from European examples in the collection.

Cerioides aurata Curran

CURRAN, 1927, Bull. Amer. Mus. Nat. Hist., LVII, p. 83.

Male, Jambuva, Congo, November 29, 1913 (J. Bequaert).

MICRODON MEIGEN

In his treatment of the Ethiopian Syrphidae Bezzi divided the genus *Microdon* into six groups but I find it impossible to follow him. The genus is a very difficult one and while I have prepared a key to the described species I realize that it may not prove entirely satisfactory because it is based very largely upon descriptions.

The group designated as "*punctulatus*" by Bezzi is based upon male characters only and is quite untenable while groups II and III are very feebly separated. Since the same characters have not been mentioned by various authors in describing species it is difficult to place many of those described in their exact places, hence the use of groups of any sort has been discarded. Unfortunately I am unable to place *punctulatus* Wiedemann in the key as the description does not give the relative lengths of the antennal segments. It seems likely that one of the species included will fall to *punctulatus* but an examination of the type will be necessary in order to establish its identity.

TABLE OF SPECIES

1.—Third abdominal segment wider than the second; slender species............2.
Third segment not wider than the second................................3.
2.—Mesonotum golden yellow in front of the scutellum...*acantholepidis* Speiser.
Mesonotum with rather silvery pubescence..................*illucens* Bezzi.
3.—Scutellum without spines or deep apical emargination......................4.
Scutellum either with spines or deeply notched apically..................17.
4.—Abdomen reddish or yellowish..5.
Abdomen partly or wholly black or brownish................................9.
5.—Legs wholly black..6.
Legs mostly reddish or yellowish...7.
6.—Abdomen reddish.......................................*erythros* Bezzi.
Abdomen yellow......................................*luteiventris* Bezzi.
7.—Posterior legs wholly reddish or yellowish..............................8.
Posterior legs partly black..........................*aethiopicus* Rondani.
8.—Arista reddish; wings uniformly blackish....................*inermis* Loew.
Arista black; wings brownish along the veins................*pallidus* Bezzi.
9.—Third antennal segment about four times as long as the basal two combined...*villosus* Bezzi.
Third segment not twice as long as the first two..........................10.
10.—Femora and tibiae wholly reddish; head bright reddish..*erythrocephalus* Bezzi.
Femora at least partly black...11.
11.—Very large blackish species, the wings broadly blackish in front; femora partly reddish; length at least 20 mm..........................*mydas* Bezzi.
Smaller, length not greater than 15 mm...................................12.
12.—Third antennal segment black or brown...................................13.
Third antennal segment reddish..............................*rugosus* Bezzi.
13.—First antennal segment as long as the third or longer....................16.
First antennal segment shorter than the third............................14.
14.—Mesonotum bordered with brassy yellow, or yellowish-gray, appressed hair..15.
Mesonotum with black and grayish-white hair.............[1] *captum* Speiser.
15.—Anterior four legs mostly reddish, the anterior tarsi broadened; wings hyaline with light gray apex..........................*cremastogastri* Speiser.
Legs wholly black or reddish brown, the anterior tarsi not broadened; wings pale brownish, more grayish posteriorly.........*appendiculata* Curran.
16.—Apical tarsal segments broader than long......................*apis* Speiser.
Apical tarsal segment decidedly longer than wide....*inappendiculata* Curran.
17.—Scutellum yellowish...18.

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[1] *M. punctulatus* Wiedemann is omitted. It appears to come here an may be the same.

Scutellum brown, black, or metallic..................................19.
18.—Legs brown or black, the tarsi reddish....................*bequaerti* Curran.
Legs reddish yellow, the posterior pair and bases of the anterior four femora brown or blackish.............................*tarsalis* Hervé-Bazin.
19.—Femora blackish or metallic.......................................21.
Femora reddish, more or less darkened basally...........................20.
20.—Face broad, not constricted below.....................*obesus* Hervé-Bazin.
Face constricted below................................*testaceus* Walker.
21.—Frontal pile mostly black..22.
Frontal pile wholly pale.............................*hova* Hervé-Bazin.
22.—Tibiae pale pilose on the basal half................................23.
Tibiae pale pilose only at the base.......................*sudanus* Curran.
23.—Thorax with whitish or yellowish hair..............................24.
Thorax black-haired in the male; mostly black-haired in the female..*tenuifrons* Curran.
24.—Hair of the mesonotum rich brassy yellow............................25.
Hair of the mesonotum whitish...........................*brevicornis* Loew.
25.—Scutellum with strong spines....................*wainwrighti*, new species.
Scutellum emarginate and biangulate apically but without spines...*liberiensis* Curran.

Microdon erythros Bezzi

Bezzi, 1908, Ann. Soc. Ent. Belg., LII, p. 383.

Two males, Eden, Cameroon (J. A. Reis).,

Microdon inermis Loew

Loew, 1857, Ofvers. Kongl. Vet. Akad. Förhandl., p. 376.

Male and female (in cop.), Gbanga, Liberia, 1926 (J. Bequaert).

Microdon appendiculata Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 6.

The known specimens are from Kakatown and Gbanga, Liberia, collected by Dr. Bequaert in 1926.

Microdon inappendiculata Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 7.

Known only from Kakatown, Liberia, August, 1926.

Microdon bequaerti Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 3.

Described from Gbanga, Liberia, 1926 (Bequaert).

This species and *tarsalis* Hervé-Bazin are evidently closely related but they may be readily separated by the color of the legs.

Microdon tenuifrons Curran

CURRAN, 1929, Amer. Mus. Novit., No. 340, p. 5.

The male was described from Camp No. 3, Du River, Liberia. In the same collection was a female from Lenga Town, Liberia, August 15, 1926, which I did not associate with the male but which may prove to be the same species. The antennae are a little longer, there is considerable brownish-yellow pile on the thorax, and the abdomen is wholly bluish. Inasmuch as *brevicornis* Loew has white-haired thorax I am inclined to think that my original impression that this specimen should be referred to *brevicornis* was wrong. The specimens contained in the last four couplets of the key are all closely related and distinctive characters exhibited by the males are less marked in the opposite sex.

Microdon liberiensis Curran

CURRAN, 1929, Amer. Mus. Novit., No. 340, p. 4.

I have seen only the type series, comprising two males and one female from Liberia and a male from Cameroon.

Microdon brevicornis Loew

LOEW, 1857, Ofversl. Kongl. Vet. Akad. Förhandl., XIV, p. 376.

Female, Salisbury, S. Rhodesia, February, 1929 (A. Cuthbertson).

Microdon illucens Bezzi

BEZZI, 1915, 'Syrph. Ethiop. Reg.,' p. 121.

Twelve males and two females, Algoa Bay, Cape Province, February 15 to March 23, 1896 (Dr. Brauns); one male, Kowie, November 30, 1896 (Dr. Penther).

Microdon wainwrighti, new species

A short, robust species with spined scutellum and short antennae. Length, 8 mm.

MALE.—Front very narrow at the depression, gradually widening to the antennae and to the vertex, very much wider at the vertex than at the antennae; ocellar triangle small, situated near the middle of the upper section of the front. Occiput black, with cinereous pollen. Cheeks linear. Face narrow and slightly narrowing below, moderately convex. Face and front metallic dark green. Pile yellow, paler on the face, a patch of black hair above the antennae and some black hairs about the ocellar triangle. Antennae black, shorter than the head, the first and third segments of about equal length; arista reddish brown, slightly longer than the third segment.

Mesonotum and scutellum metallic dark green, posterior calli and pleura reddish or reddish yellow, the sternum shining brown. Pile rich reddish yellow dorsally, pale yellowish on the pleura. The brown scutellar spines are moderately separated by a fairly deep concavity and bear pile on the basal half or more.

Coxae, trochanters, and femora brown, the trochanters more or less broadly reddish or reddish yellow apically; posterior femora basally and the apices of all the femora, yellowish, each reddish on the apical half of the ventral surface. Tibiae yellow with the apical third brown. Tarsi brown with the last segment reddish on the apical half. Pile yellowish, very pale on the tibiae, black on the upper surface of the apical tarsal segments.

Wings cinereous hyaline, with brown veins; apical crossvein gently recurrent and only slightly curved, the apical cell angulate behind. Squamae and halteres very pale yellow.

Abdomen clay yellowish, a broad median vitta on the third and fourth segments and about the basal half of these segments brown and with appressed black pile, the pile elsewhere pale brassy yellow, becoming almost white apically. Under surface wholly reddish yellow; genitalia rather small, rusty reddish. The abdomen is decidedly wider than the thorax and only about one-fourth longer than wide.

HOLOTYPE.—Male, Lourenço Marques, April–July, 1914 (H. A. Junod), received from Mr. Colbran J. Wainwright.

CITABAENA WALKER

Many of the species belonging to this genus are very similar in general appearance and, while the species may be divided into fairly satisfactory groups, the characters all intergrade. There is a quite evident sexual dimorphism in some of the species so that it is not always easy, without an abundance of material, to associate the two sexes. The following key includes all the African species known to me, but inasmuch as it is based to a large extent upon descriptions only it is not possible to use all available characters.

TABLE OF SPECIES

1.—Wings with strongly brown bordered crossveins.......... *maculipennis* Bezzi.
Wings not strikingly bicolored.......................................2.
2.—Posterior femora without sub-basal spur below.......................3.
Posterior femora with strong, sub-basal spur below............ *armipes* Bezzi.
3.—Eyes of males broadly separated....................................4.
Eyes of males touching or almost so...................................8.
4.—Abdomen of male with lunules..5.
Abdomen of male with large lateral silvery spots .... *argenteus* Walker.
5.—Abdominal lunules broadly separated in the middle.......................6.
Abdominal lunules approximate in the middle.............................7.
6.—Scutellum black................................ *argyropsis* Bezzi.
Scutellum reddish.............................. *rubiginosus* Hervé-Bazin.
7.—Stigma brown; lunules whitish........................ *lugens* Wiedemann.
Stigma colorless; lunules yellow..................... *jacobi* Hervé-Bazin.
8.—Eyes with conspicuous hair..9.
Eyes bare or practically so..25.
9.—Abdomen reddish basally, at least on the sides............................10.
Abdomen wholly black except the tip or with yellow markings............11.

10.—Femora black.......................................*lunatus* Fabricius.
Anterior four femora reddish..........................*axinecerus* Speiser.
11.--Dorsum of second and third segment entirely silvery, concealing the ground color..*paulae* Hervé-Bazin.
Abdomen not silvery as above..12.
12.—Abdomen with yellow lunulate markings or spots..........................13.
Ground color not yellow beneath the lunules, sometimes obscurely reddish...14.
13.– Female front without black pile above antennae (♀ only)...*varipennis*, new species.
Female front with black pile immediately above antennae...................36.
14.—Third antennal segment partly reddish...................................15.
Third antennal segment wholly black ....19.
15.– Anterior four femora reddish........................*axinecerus* Speiser.
Femora broadly black basally..16.
16.– Anterior four tibiae wholly red; stigma brown..........*erythrocerus* Loew.
Anterior four tibiae blackish on apical half ....17.
17.--Scutellum wholly black...18.
Scutellum with yellow apex..........................*dolichocerus* Speiser.
18.—Scutellar pile erect..36.
Scutellar pile extremely short; front of female narrow, the ocellar triangle elongate.......................................*barbarus* Coquebert.
19.– Posterior tarsi with only appressed hair................................22.
Posterior tarsi with erect hair above, at least on the basal segment.......20.
20.—Only the first segment of the posterior tarsi with erect hair............21.
All the segments of the posterior tarsi with erect hair.......*obliquus* Fabricius.
21.—Fourth abdominal segment wholly pollinose on posterior half..*vestitus* Bezzi.
Fourth abdominal segment broadly shining laterally on the posterior half...*efflatouni*, new species.
22.- Posterior tarsi wholly black-haired...............*latitarsis* Macquart.
Posterior tarsi at least partly whitish or yellowish-haired above or on the sides ....23.
23.- Scutellum wholly black..24.
Scutellum with yellowish or grayish apex.......................*scaber* Bezzi.
24.—Scutellar teeth very conspicuous; sides of mesonotum not pollinose on the whole length.......................................*integer* Bezzi.
Scutellar teeth inconspicuous..35.
25.--Abdomen with yellowish spots..26.
Abdomen without yellowish lunules..27.
26.—Abdomen with one pair of yellow spots or in part red......................33.
Abdomen with two pairs of yellow spots...........*quadrimaculatus* Macquart.
27.—Third antennal segment wholly black.......................................29.
Third antennal segment partly or wholly reddish............................28.
28.—Femora reddish..................................*rufipes* Hervé-Bazin.
Femora black...34.
29.—Abdominal lunules strongly developed......................................30.
Abdominal lunules very weak...*unicolor* Loew.
30.—Legs partly reddish...31.
Legs wholly black...........................*triangularis* Hervé-Bazin.

31.—Scutellum with yellowish apex..32.
Scutellum wholly black............................*villeneuvei* Hervé-Bazin.
32.—Fourth abdominal segment almost wholly pollinose behind the lunules......
....*efflatouni*, new species.
Fourth segment mostly shining except for the lunules..........*feae* Bezzi.
33.—Male genitalia very small..........................*bequaerti* Hervé-Bazin.
Male genitalia moderately large; yellow spots on second abdominal segment large..38.
34.—Scutellum with yellow apex..........................*dolichocerus* Speiser.
Scutellum wholly black..................................*amoenus* Loew.
35.—Sides of mesonotum broadly pollinose on the whole length (Canary Islands)....
....*purpureus* Macquart.
Sides of mesonotum very narrowly pollinose......*wainwrighti*, new species.
36.—Wings cinereous hyaline...37.
Wings brown, the base broadly pale.................*varipennis*, new species.
37.—Front of female wide, narrowing anteriorly............*capensis*, new species.
Front of female narrow, gently widening anteriorly...........*serratus* Bezzi.
....*paulae* Hervé-Bazin.
38.—Abdomen in part red- See couplet 10.
Abdomen with only the pale spots......................*pipizoides* Speiser.

Citabaena wainwrighti, new species

A moderately large black species, the wings pale brownish, the gray lunules weak and narrowly separated; antennae wholly black; eyes strongly pilose. Length, 9 mm.

FEMALE.—Pile whitish, rather long and abundant, a very broad band of black pile in front of the vertex and an incomplete band immediately above the antennae. Front moderately wide, widening anteriorly, shining except for a narrow strip of cinereous pollen on the lower half along the orbits. Ocellar triangle almost twice as long as wide, the upper ocelli situated near the upper angles of the eyes. Occiput cinereous pollinose except above, the face with similar pollen. Antennae wholly black, large, the third segment orbicular, slightly longer than wide, in outline slightly flattened beyond the arista.

Thorax slightly shining blue-black, the mesonotum with a pair of narrow, cinereous pollinose vittae extending from the front margin to the posterior fifth. Pile moderately long, pale cinereous yellow. Scutellum strongly margined and weakly dentate.

Legs black; posterior femora moderately swollen; knees reddish, tarsi brown. Pile white, the posterior tibiae with a large patch of brown pile near the middle on the dorsal surface.

Wings pale brown, somewhat paler basally. Squamae white. Halteres yellow.

Abdomen slightly shining black, densely, finely punctate, with three pairs of cinereous pollinose spots forming oblique, arcuate bands that end well inside the lateral margins, the spots only narrowly separated from each other and situated in extremely weak depressions. The pile is whitish, black in front of and behind the pollinose spots except on the second segment where it is wholly pale anteriorly.

HOLOTYPE.—Female, Johannesburg, S. Africa, August, 1894 (J. P. Cregoe), received from Mr. Colbran J. Wainwright.

Citabaena varipennis, new species

Readily distinguished from known African species by having the wings brown on the apical two-thirds. Length, 5 to 6 mm.

MALE.—Eyes with short black hairs, contiguous for a short distance. Frontal triangle pale yellowish pollinose and with pale pile. Vertical triangle long, with brownish-yellow pollen in front of the ocelli, which are situated near its middle, their triangle slightly longer than wide. Pile black in front, white behind the ocelli and on the occiput and face. Occiput with white pollen. Cheeks linear, bare on more than the anterior half. Face white pollinose, bluish in ground color. Antennae orange, the basal segments and arista brown, the third segment broadly brownish above on the outer surface, convex above, almost straight below, the end sharply rounded.

Thorax shining black, the pleura greenish black and thinly cinereous pollinose; mesonotum with a pair of gray pollinose vittae extending from the anterior border to behind the middle. Pile yellow, paler on the pleura; a number of coarse black hairs above the roots of the wings. Scutellum strongly margined and bearing four pairs of small teeth, the preapical depression with very large punctures.

Legs black; tips of the anterior four femora, basal third or less of their tibiae and their tips, and the anterior four tarsi yellow; tips of the posterior femora and the base of their tibiae reddish. Posterior tarsi brown and slender; posterior femora not enlarged and without unusual spines. Pile cinereous white.

Wings brown, hyaline on about the basal third. Squamae white. Halteres yellow.

Abdomen black, slightly bronzed, with three pairs of rather small, oblique, gray pollinose spots, the spots on the second segment largest, almost transverse in front and strongly tapering to the posterior outer ends. Pile black, short and appressed, white on the pollinose spots, first segment, and entire lateral margins. Genitalia with black hair. Fifth sternite with long, posteriorly directed brown bristles on the apex except at the sides, the sternites with pale pile.

TYPES.—Holotype, male, and paratype, male, Lourenço Marques, April–July, 1914 (H. A. Junod), received from Mr. Colbran J. Wainwright. Type returned to Mr. Wainwright; paratype in The American Museum of Natural History.

Citabaena axinecerus Speiser

Eumerus axinecerus SPEISER, 1910, 'Kil.-Meru Exp.,' X, p. 129.

Male, Umtali District, Southern Rhodesia, November 2, 1931 (P. A. Sheppard); female, Bulawayo, Southern Rhodesia, July 27, 1923.

The hairs on the eyes are so minute in this species that they are usually visible only under high power. Inasmuch as they may appear quite bare the species has been included in both sections of the key. The male may be readily distinguished from *lunatus* Fabricius by having the vertical triangle almost wholly pollinose. In *lunatus* it is shining except in front.

Citabaena lunatus Fabricius

Syrphus lunatus FABRICIUS, 1794, 'Ent. Syst.,' IV, p. 296.

Male, Cape Town, S. Africa, April 4, 1920 (M. Bequaert).

This species has not been previously known from the Ethiopian region.

Citabaena serratus Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 111.

Male, Lukolela, Congo, January 7, 1931.

Citabaena capensis, new species

Greenish black, with thinly pilose eyes and large, brownish-red antennae. Length, 7.5 mm.

Female.—Head greenish black, the face, cheeks, and occiput cinereous-white pollinose, the frontal orbits pollinose on the lower half; pile cinereous white, paler on face and cheeks, a band of black pile across the ocelli. Front narrowest at the anterior third, slightly widening anteriorly and strongly widening to the vertex; ocellar triangle slightly wider than long, the posterior ocelli situated conspicuously in front of the upper angles of the eyes. Antennae brownish red, the upper border of the third segment darker, the arista brown; third segment suborbicular, gently narrowed apically.

Thorax shining blackish green, with pale yellow pile, the pile on the pleura becoming whitish below. Mesonotum with a pair of weak, cinereous pollinose vittae extending to the posterior fourth. Scutellum margined, finely serrate apically.

Legs black, the trochanters, tips of the femora and tibiae, basal half of the tibiae, and the tarsi, reddish, the posterior tarsi brownish red. Posterior femora rather strongly swollen. Pile pale yellowish on the femora, more whitish on the tibiae and tarsi.

Wings cinereous hyaline, the stigma yellow. Squamae white, the halteres reddish yellow.

Abdomen shining black, with three pairs of gray-pollinose lunules, the sides more or less bronzed. Pollinose spots on second segment oblique, straight, of almost equal width throughout, lunules on the third segment broadly separated from each other and from the lateral margins, their inner ends broadest and rounded, the outer ends curved sharply forward and obliquely truncate; lunules on the fourth segment largest, shaped like those on the third, but wider inwardly, and narrower outwardly where they are carried forward to a greater degree. Pile brassy yellow on the base, lateral margins, and on the lunules; produced inward in the form of a short, broad fascia on the apex of the second segment, and in the form of a small triangle on the base of the fourth, the apex of the fourth wholly pale pilose behind the posterior portions of the lunules; dorsum with shorter, appressed black pile. Fifth segment and venter wholly pale haired.

Holotype.—Female, Cape Town, South Africa.

This species probably belongs to the group in which the eyes of the male are separated. It bears a superficial resemblance to *obliquus* Fabricius but is at once distinguished by the wide front.

Citabaena sudanus, new species

Resembling *obliquus* Fabricius but with shorter pilose eyes, much more extensively pollinose thorax, wholly pale pilose head, etc. Black, with cinereous-white pollen. Length, 7.5 mm.

MALE.—Head thickly white pollinose, the vertical triangle with thinner, yellowish tinged pollen and rather long pale yellowish pile, the pile elsewhere white. Eyes touching for a short distance, the vertical triangle rather suddenly narrowed in front, the ocellar triangle situated at the middle and more than twice as long as wide. Eyes sparsely short pilose. Antennae reddish brown, the arista black apically; third segment decidedly longer than wide, gently widening from the base to the apical third, thence oblique to the lower apex which is sharply rounded.

Thorax cinereous pollinose, the disc of the mesonotum behind the suture shining black, a pair of narrow, shining vittae extending forward almost to the anterior margin of the thorax; an oval shining spot toward each side in front of the suture. Pleura shining in front and behind. Pile yellow dorsally, white on the pleura. Scutellum with whitish apical border, narrowly margined.

Legs reddish brown, the tips of the femora, basal fourth of the posterior tibiae, and the anterior tibiae and tarsi yellow. Posterior femora rather strongly swollen; posterior tibiae somewhat enlarged; basal segment of the posterior tarsi laterally compressed and heightened and with moderately long black hair above, the other segments with short black hair. Pile whitish.

Wings cinereous hyaline, the stigma yellowish. Squamae white. Halteres yellow.

Abdomen black, the apices of the segments more or less broadly brownish. Pollinose lunules on second segment strongly oblique, reaching the posterior corners broadly, narrowly separated in the middle, and produced forward laterally as large, obtuse triangles to the anterior sixth of the segment. The lunules on the third segment are arcuate, slightly broader and connected with a rectangle of gray pollen on the posterior corners, the lateral margin narrowly pollinose, produced in front as a small, obtuse triangle. Lunules on the fourth segment largest, broader, connected posteriorly with the broadly pollinose posterior border, the pollen on the sides of the segment broadly expanded on the anterior half. Pile white, shorter and black on the bare portions of the second and third segments and on the anterior third of the fourth segment. Genitalia shining reddish brown, and black pilose. Fifth sternite brownish red, the pile pale on the venter.

HOLOTYPE.—Male, Khartoum, Sudan, June 14, 1916.

Citabaena efflatouni, new species

Eumerus vestitus EFFLATOUN, 1922, Mem. Soc. Ent. Egypt, II, p. 113.

Related to *vestitus* Bezzi, but differing in having the fourth abdominal segment much more extensively shining, less pollinose thorax, etc. Black, the legs partly reddish yellow. Length, 8 mm.

MALE.—Face and frontal triangle densely yellowish cinereous pollinose, the occiput with whitish pollen. Vertical triangle large, black, thinly yellowish-brown pollinose, ocellar triangle twice as long as wide, situated a little in front of the middle of the vertical triangle. Pile whitish, yellow on the upper part of the occiput and in front of the anterior ocellus, black on most of the vertical triangle. Antennae black; third segment a little longer than wide, its sides subparallel, its apex oblique.

Thorax black, the sides of the mesonotum bronzed, the pile brassy yellow. Pollen cinereous yellow, very thin on the dorsum, where it is limited to the sides and anterior margin, leaving a pair of approximated black vittae in the middle in front.

No pollinose vittae. Scutellum with the thinned margin very weakly serrate and densely grayish-yellow pollinose.

Legs black; tips of the femora, broad bases of the tibiae, the apices of the anterior four, and their tarsi dark reddish yellow. Posterior femora and tibiae moderately swollen; basal segment of the posterior tarsus with a high ridge, deeply excavated posteriorly along almost the whole length, in front gently concave along most of the length, the ridge with thick, short black hair on its crest. Posterior tarsi brownish red in color and with black hair above. Pile pale yellowish.

Wings cinereous hyaline; stigma brown. Squamae and halteres yellow.

Abdomen slightly shining black, with three pairs of cinereous-yellow pollinose lunules, the third poorly distinguished from the adjacent pollen. The first pair of spots are almost straight and extend from the anterior margin, close to the middle, to the posterior corners. Second pair of spots gently lunulate and extending from the anterior fifth to the posterior corners. The spots on the fourth segment are concave in front, only slightly more dense than the pollen behind, which connects them with the posterior border of the segment, leaving a median, shining stripe: the base of the segment bears a very broad, incomplete shining fascia that is connected sublaterally with a large shining area occupying the posterior corners of the segment. The sides of the second segment are broadly pollinose and there is a large, basal triangle of pollen on each side of the fourth; on the second there is a weak stripe of pollen extending forward from the lunules inside the lateral margins. All the pollen is coarsely punctate and more especially that on the fourth segment. Pile dull brassy yellowish, black on the shining parts of the third segment and in the middle and on the base of the fourth. Genitalia shining black and black-haired. Venter with pale pile.

HOLOTYPE.—Male, Ezbet el Nakhe, Egypt, March 20, 1924 (H. C. Efflatoun).

C. vestitus Bezzi was described from Portuguese Guinea, and while the present species agrees with the description in many respects there are several differences that indicate that the two are quite distinct.

Citabaena obliqua Fabricius

Milesia obliqua FABRICIUS, 1805, 'Syst. Antl.,' p. 194.

Male and female, Boma, Congo, June 9, 1915; male, Mt. Ruwenzori, Congo, June 5, 1914; female, Lubutu, Congo, February 6, 1915; male, Du River, Camp No. 3, Liberia (Jos. Bequaert); male, Salisbury, S. Rhodesia, January, 1901 (F. L. Snow); male, Lourenço Marques, January–March, 1914 (H. A. Junod); male, Botshabelo, near Middleburg, Transvaal, 4000 ft. (H. A. Junod); two females, Basutoland; male, Salisbury, Southern Rhodesia, December, 1931.

Citabaena intiger Bezzi

Eumerus integer BEZZI, 1921, Broteria, ser. zool., XIX, p. 16.

Female, Mt. Ruwenzori, Congo, April 21, 1914 (J. Bequaert).

Citabaena feae Bezzi

Eumerus feae Bezzi, 1912, Ann. Mus. Genova, XLV, p. 440.

Male, Lesse, Congo, July 21, 1914; male, Lisala, Congo, October, 1924; male and female, Banga, Liberia, October, 1926; three males and two females, Du River, Camp No. 3, Liberia (J. Bequaert); female, Lukolela, Congo, December 16, 1930 (J. P. Chapin).

Citabaena paulae Hervé-Bazin

Eumerus paulae Hervé-Bazin, 1913, Rev. Zool. Afr., III, p. 79.

Two males and one female, Lourenço Marques, April–July, 1914, and one male, Botshabelo, near Middleburg, Transvaal, 4000 ft. (H. A. Junod).

GRAPTOMYZA WIEDEMANN

This genus contains a rather small number of species occurring in tropical regions of the Old World. The African species are separable as follows.

TABLE OF SPECIES

1.—Abdomen wholly bluish .... *sauvissima* Karsch.
Abdomen black, with yellowish markings .... 2.
2.—Face with a median black vitta .... 4.
Face wholly yellow .... 3.
3.—Face, from frontal view, almost twice as wide as either eye ...... *signata* Walker.
Face narrower than either eye .... *mitis* Curran and Bryant.
4.—Legs yellow, the posterior femora broadly reddish apically... *xanthopoda* Bezzi.
Posterior femora and tibiae more than one-third black .... 5.
5.—Face, from frontal view, scarcely over two-thirds as wide as either eye .... 6.
Face as wide or wider than either eye .... 7.
6.—Scutellum not one-third as long as wide .... *breviscutum* Curran.
Scutellum two-thirds as long as wide .... *triangulifera* Bigot.
7.—Thorax and apical half of abdomen golden pilose .... *aurea* Bezzi.
Pile pale yellowish or cinereous .... 8.
8.—All the femora largely black .... *nigra* Bezzi.
Anterior four femora wholly yellow (*varia* Walker?) .... *vittigera* Bigot.

Graptomyza breviscutum Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 7.

The type was taken at Lesse, Congo, by Dr. J. Bequaert on flowers of *Bidens pilosa.*

Graptomyza triangulifera Bigot

Ptilostylomyia triangulifera Bigot, 1882, Bull. Soc. Ent. France, p. cxiv; 1884, Ann. Soc. Ent. France, p. 322.

Curran, 1927, Bull. Amer. Mus. Nat. Hist., LXVII, p. 49.

Female, Lesse, Congo, July 21, 1914, at flowers of *Bidens pilosa;* female, Lubutu, Congo, February 6, 1915; female, Kakatown, Liberia, August 18, 1926 (J. Bequaert); male, Lukulela, Congo, January 13, 1931 (J. P. Chapin).

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RECORDS AND DESCRIPTIONS OF AFRICAN SYRPHIDAE.—II (DIPTERA)

By C. H. Curran

The preceding paper in this series dealt with a number of genera that are more or less isolated from the general group of Syrphids. The present contribution deals with the Syrphinae, a group recognized by the absence of pile on the humeri, the head being concave posteriorly and usually mostly concealing the humeri.

CHRYSOTOXUM MEIGEN

But one species is known from the Ethiopian region.

Chrysotoxum continum Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 118.

Female, Kabale, Uganda, April 9, 1927.

AFROSYRPHUS CURRAN

This genus contains only one known species and was originally described from a single male from the Belgian Congo. The species resembles some representatives of the genus *Ischyrosyrphus* Bigot but the antennae are very long and porrect as in the genus *Chrysotoxum*.

Afrosyrphus varipes Curran

Curran, 1927, Bull. Amer. Mus. Nat. Hist., LVII, p. 50.

Male, Yambuya, Congo, November 29, 1913; male, Lesse, Congo, July 21, 1914; female, Walikale, Congo, January 7, 1915 (J. Bequaert).

The extent of the dark color on the abdomen varies considerably, in one male only the first segment, basal half and narrow apex of the second segment being reddish yellow. The female agrees with the male in almost all respects. The abdomen is blackish, thinly gray pollinose, the first and second segments as described above, the third and fourth each with a broad, interrupted sub-basal reddish fascia and the apex reddish, the fasciae not extending over the lateral margins. The front gradually narrows from below to the vertex, is shining black with a band of brown pollen occupying the median third and a narrow stripe of whitish pollen along the orbits on the lower third, the frontal pile black on the upper two-thirds, yellow below; the vertical triangle is swollen and thickly hairy, the space between it and the orbits bare. The face may be either yellow or brownish in ground color, the cheeks always yellowish.

ASARKINA MACQUART

This genus, which closely resembles *Syrphus* has the abdomen unusually flattened and strongly margined and the facial tubercle is quite often "pinched" or concave laterally. The genus occurs only in the Old World.

TABLE OF SPECIES

1.—Face wholly yellowish..2.
Face with median black stripe or spot..11.
2.—Frontal triangle flat, short yellow pilose, the antennal prominence not developed; front of female yellow pilose anteriorly; scutellum wholly yellow pilose; small species, length less than 9 mm................ *minor* Bezzi.
Frontal triangle rarely flat, if so black pilose and the scutellum partly black-haired, larger, broader species, more than 11 mm. in length. ....3.
3.—Metascutum evenly convex from side to side, not sulcate..................4.
Metascutum with a distinct and often deep median sulca................7.
4.—Ventral scutellar fringe yellow..5.
Ventral scutellar fringe black........................*punctifrons* Austen.
5.—Face yellow pollinose..6.
Face wholly white pollinose........................*medjensis* Curran.
6.—Metascutellar sulca weak but distinct; front of male with black spot; scutellum more than half black pilose; facial tubercle not more prominent than the oral margin........................*usambarensis* Bezzi.
Metascutum without trace of sulca; frontal triangle wholly pale; scutellum black haired on only the apical third; facial tubercle much more prominent than the oral margin........................*liberia*, new species.
7.—Frontal triangle black pilose in male, the front of the female black pilose on its whole length..8.
Frontal triangle yellow pilose, the front of the female yellow pilose on the lower third..*africana* Bezzi.
8.—Face yellow pollinose, at most whitish near the cheeks....................9.
Face white pollinose..*albifacies* Bezzi.
9.—Black abdominal fasciae not more than one-sixth as wide as the length of the third abdominal segment..10.
Black fasciae almost one-third as wide as the segmental length. .*gemmata* Bezzi.
10.—Supra-antennal area reddish........................*ericetorum* Fabricius.
Supra-antennal area black........................*usambarensis* Bezzi.
11.—Facial tubercle cariniform, the sides flattened..............*amoena* Austen.
Facial tubercle without flattened sides..12.

12.—Facial black stripe occupying the lower half of the face or more............13.
Facial black spot limited to a quadrate spot below.............*fiorii* Bezzi.
13.—Eyes bare.... ....14.
Eyes pilose..*hirsuticeps* Bezzi.
14.—Yellow fasciae on third and fourth abdominal segments narrowed in the middle..*eremophila* Loew.
Yellow fasciae on third and fourth abdominal segments not narrowed medianly.......................................*rostrata* Wiedemann.

Asarkina minor Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 27.

One male, Gbanga, Liberia, September, 1926 (J. Bequaert).

The metascutum is evenly convex from side to side. *A. medjensis* Curran is related to *minor* but has the front of the male black haired and is considerably larger.

Asarkina medjensis Curran

Curran, 1927, Bull. Amer. Mus. Nat. Hist., LVII, p. 52.

The type male was from Medje, Congo. There is a female before me collected by Dr. J. Bequaert on Mt. Ruwenzori, Congo, April 11, 1914, at an altitude of 1800 m., and two males and five females from Lourenço Marques (H. A. Junod).

The female has the front reddish on the lowest fourth, wholly black haired and mostly brownish ochreous pollinose. The antennal tubercle is distinct. Black abdominal fasciae about as wide as in *punctifrons*, the one on the sixth segment reduced to a pair of small median spots.

Asarkina punctifrons Austen

Austen, 1909, Trans. Zool. Soc. London, XIX, p. 89.

Male, Bafuka, Uele, Congo (Rodhain); male, Pengo, Congo, February 10, 1914 (J. Bequaert); two males, Eden, Cameroons (J. Reis); male and female, Lenga Town, Liberia, August 15, 1926; male, Paiata, Liberia, October, 1926 (J. Bequaert); male, Lourenço Marques, January–March, 1914 (H. A. Junod).

Asarkina usambarensis Bezzi

Asarcina ericetorum usambarensis Bezzi, 1908, Ann. Mus. Nat. Hung., VI, pp. 495–504.

Male, Stanleyville, Congo, March, 1915 (Lang and Chapin); four males, Lenga Town, Liberia, August 15, 1926 (J. Bequaert); male and four females, Lourenço Marques, January–March, 1914 (H. A. Junod); male, Ricatla, Delagoa Bay (Janson); male, N. W. Tanganyika, 1910 (Grauer).

This species is very close to *ericetorum* Fabricius but the black supra-antennal spot and mostly black pilose scutellum will distinguish it.

Asarkina africana Bezzi

Asarcina ericetorum africana Bezzi, 1908, Ann. Mus. Nat. Hung., VI, p. 499.

A male from Lourenço Marques, April–July, 1914, and one from Sierra Leone.

Asarkina gemmata Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 26.

Female, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson).

Asarkina liberia, new species

Frontal triangle wholly reddish; abdomen orange with narrow black segmental apices. Length, 13 to 14.5 mm.

Male.—Head black, the face and frontal triangle reddish yellow, reddish yellow pollinose, the pollen becoming white along the lower facial orbits. Pile yellow, silvery white on the lower half or more of the occiput; long and black on the frontal triangle; very short and black on the vertical triangle except at the vertex where it is short and reddish yellow. Ocellar triangle long, less than one-fifth as long as the shining black, elongate vertical triangle, the eyes touching for a shorter distance than the length of the latter triangle. Occiput whitish pollinose, becoming brownish yellow above. Cheeks shining black except anteriorly, where the orange color extends along the oral margin. Face prominent, the tubercle conspicuous and distinctly more prominent than the oral margin, its sides "pinched" and slightly concave; face very gently convex below the antennae, the tubercle arising abruptly. Antennae reddish, third segment broadly brown above on the inner surface, a little more than twice as long as wide and gently tapering from the basal third to the rounded apex; arista reddish basally, brown apically.

Mesonotum shining greenish black, the sides broadly pale orange, the middle very broadly and thinly brownish pollinose. Mesopleura and pteropleura mostly reddish in ground color, the pleura with reddish-yellow pollen. Scutellum pale orange. Pile reddish yellow, black on the apical third of the scutellum; ventral scutellar fringe pale.

Legs reddish yellow, the posterior tarsi brown beyond the first segment, the anterior four more or less brownish above. Pile reddish yellow, black on the upper surface of the posterior tibiae and on the upper surface of all the tarsi; posterior femora with black hair on the anterior surface except basally.

Wings with luteous tinge; stigma pale brownish. Third vein gently dipped into apical cell. Squamae and halteres reddish yellow.

Abdomen orange, the segments black on the apical fifth or less, the black only slightly produced forward in the middle. First segment black on the median half, the second with a small basal brown triangle in the middle. Pile reddish yellow, black on the lateral margins except basally, on the black fasciae, on the whole of the fifth segment and on the apical half of the fourth in the middle. Genitalia reddish.

FEMALE.—Front shining black, wholly black pilose, the vertex more or less violaceous, the sides very broadly, rich brownish yellow pollinose to above the middle; ocellar triangle scarcely longer than wide, situated well forward. Sixth abdominal segment at least half black.

TYPES.—Holotype, male, and allotype, female, Gbanga, Liberia, September, 1926 (J. Bequaert). Paratypes, three males, same data and one male, Lenga Town, Liberia, August 15, 1926 (J. Bequaert); female, Eden, Cameroons (J. A. Reis).

SYRPHUS FABRICIUS

This name should be applied, properly, to those species in which the lower lobe of the squamae is pilose above. As so limited the genus is a small one, *S. ribesii* Linnaeus from northern Africa and Europe, being the lone representative. The remaining species belong to a number of segregates—*Metasyrphus*, *Epistrophe*, *Stenosyrphus*, etc.,—but in view of the fact that I do not have representatives of all the species I am retaining them under *Syrphus* for the present. For convenience I divide the species into two groups, one with the sides of the abdomen margined as in *Syrphus* s.s., the other with simple lateral margins.

SECTION I

This group has the lateral margins of the abdomen raised and separated from the disc by a distinct groove. Occasionally, in drying, there is little evidence of the raised margin but the specimens can always be placed here because there is an oblique impression on the sides of the second segment, originating near the lower base and extending to the upper edge beyond the middle. As a general rule the species belonging in this group are more robust than those placed in section II. Each of these groups may be further divided by the presence or absence of pile on the metasternum.

TABLE OF SPECIES

1.—Eyes pilose...2.
Eyes bare ....*cognatus* Loew.
2.—Stigma with basal blackish spot......................................4.
Stigma wholly yellow...3.
3.—Abdomen with whitish fasciae not reaching the lateral edges.................
....*capensis* Wiedemann.
Abdomen with yellow fasciae extending over the sides.......*eutaeniatus* Bezzi.
4.—Antennae much shorter than the face, the third antennal segment short oval..
....5.
Antennae about as long as the face, the third segment very elongate........
....*inflaticornis* Bezzi.

5.—Third abdominal segment with a broad yellow fascia touching the anterior border..6.
Third abdominal segment with narrow whitish fascia broadly separated from the anterior border or with a pair of spots..........................8.
6.—Wings brownish on the basal half........................*tricolor* Walker.
Wings wholly hyaline..7.
7.—Second and fourth abdominal segments without pale fasciae.....*melas* Bezzi.
Second and fourth segments with pale fasciae..........*adligatus* Wiedemann.
8.—Third abdominal segment with a pair of oblique yellowish spots...*intersectus* Wiedemann.
Third segment with grayish fascia.......................................9.
9.—Face black or brownish yellow pilose..................................10.
Face pure white pilose................................*claripennis* Loew.
10.—The shining black fasciae on the sternites extend over the lateral margins; wings tinged with brown on the basal half............*luci*, new species.
The shining black ventral fasciae are broadly separated from the sides of the sternites; wings cinereous hyaline.....................*hirticeps* Loew.

Syrphus cognatus Loew

Loew, 1857, Ofvers. Kongl. Vet. Akad. Förhandl., XIV, p. 378.

Three males and two females, Johannesburg; male and female, Botshabelo, near Middleburg, Transvaal, 4000 ft. (H. A. Junod); female, Basutoland (Janson); male and female, Pretoria, August 27, 1914, and October 14, 1917; female, Port Sheptone, July 5, 1917; male, Tarkastad, September 29, 1922 (H. K. Munro).

Syrphus capensis Wiedemann

Wiedemann, 1830, 'Aussereur. Zweifl.,' II, p. 127.

Female, Basutoland. Also a male labelled "Cape" from the Novara Cruise.

Syrphus inflaticornis Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 31.

Three females, Lubutu, Congo, January 21, 1915, and February 6, 1915; female, Irumu to Penge, Congo, March 1, 1914; female, Burunga, Congo (J. Bequaert).

Syrphus adligatus Wiedemann

Wiedemann, 1824, 'Anal. Ent.,' p. 35.

Two males and four females, Burunga, Congo; male, Indata, Congo, February 26, 1927; female, Walikale, Congo; female, Uvira, Congo, January 28, 1927; male, Boswenda, Congo, October 22, 1914 (J. Bequaert).

Syrphus hirticeps Loew

Loew, 1857, Ofvers Kongl. Vet. Akad. Förhandl., XIV, p. 378.

Five males and six females, Addis Abbaba, Abyssinia, August 11 to 31, 1920 (B. Brown).

Syrphus tricolor Walker

Walker, 1852, 'Dipt. Saunders.,' p. 230.

Male, Johannesburg.

Syrphus luci, new species

Syrphus hirticeps Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 33 (not Loew).

Related to *hirticeps* Loew but readily distinguished by the characters given in the key.

Black, the abdomen with pale pollinose bands on aeneous ground; eyes pilose; facial pile black. Length, 9 to 10 mm.

Male.—Head black, the face reddish except for the broad oral margin and a broad, incomplete median vitta extending over the tubercle; pile yellow on the occiput, cheeks and eyes, black on the face and front. Frontal triangle shining anteriorly, rich reddish brown or brownish red pollinose above and laterally; vertical triangle shining; a few black occipital cilia above. Face slightly receding, the tubercle moderately large and prominent. Pollen of the occiput cinereous, of the face cinereous yellow. Antennae black; third segment about twice as long as wide, subcylindrical, more tapering above; arista brown, slightly longer than the third segment.

Thorax black, dulled by brownish pollen except laterally behind the suture, the notopleura and pleura with gray pollen. Pile tawny, paler on the lower part of the pleura. Scutellum dull reddish yellow, the basal corners with metallic blue-green spot; the pile black with some tawny hairs intermixed, the ventral fringe tawny.

Legs reddish, the tibiae with more or less extensive brownish stain; femora with basal two-thirds or more black; apical four tarsal segments brown. Pile yellowish, black on the tarsi and on the apices of the femora.

Wings hyaline with almost the basal half yellowish brown; stigma dark luteous, with darker basal spot. Squamae yellow, with reddish-yellow fringe. Halteres pale yellow.

First abdominal segment metallic blue-green, the lateral margins similarly colored. Second segment opaque black, with a narrow, interrupted cinereous yellow pollinose fascia behind the middle, the outer ends widest, well separated from the lateral margins, the spots tapering gradually to the acute inner ends; apex of the segment very narrowly shining. Third segment with a broad, cinereous yellow pollinose fascia lying almost wholly before the middle and slightly wider than the basal black fascia, the outer ends of the fascia widened and only narrowly separated from the lateral margins. Fourth segment with similar fascia to that on the third but it is a little narrower and lies closer to the base of the segment. Fifth segment mostly metallic greenish black, the broad apex and median vitta opaque, the broad inner ends of the metallic spots more or less pollinose. Pile reddish yellow, black on the broad apices of the second and third segment, on the apical half of the fourth and the whole of the fifth. Genitalia black, cinereous yellow pollinose. Venter shining black, the first sternite, broad bases of the three following and the broad apex of the second, grayish pollinose, the pile yellowish.

FEMALE.—Front widening from the vertex to the antennae, shining black, with a broad, yellowish brown pollinose band across the middle, the orbits cinereous pollinose below; frontal pile wholly black. Abdominal bands slightly narrower than in the male, the pile shorter, the black hair extending forward to the pollinose fascia on the third segment; fifth segment shining, the base broadly but incompletely opaque and with a triangle of yellowish pile on each side. The pollinose fasciae on the sternites may be underlain with reddish, or they may be much narrower.

TYPES.—Holotype, male and allotype, female, Mt. Ruwenzori, Belgian Congo, April 13, 19, 1914. Paratypes, male and female, same locality, April 21 and May 18, 1914, and one male, Burunga, Congo, all collected by Dr. Joseph Bequaert.

Syrphus claripennis Loew

LOEW, 1857, Ofvers. Kongl. Vet. Akad. Förhandl., XIV, p. 378.

Two females, Burunga, and one from Mt. Ruwenzori, Congo, June 3, 1914 (J. Bequaert); male and female, Johannesburg, (J. P. Cregoe); two females, Witzieshoek, S. E. Africa (Janson).

SECTION II

I place here those species in which the abdomen is not margined, the sides being curved under and thinned.

TABLE OF SPECIES

1.—Face with a black median vitta or stripe covering the tubercle.............2.
Face wholly yellow......................................4.
2.—Sides of the mesonotum wholly yellow..............................3.
Sides of the mesonotum not yellow on the whole length..................7.
3.—Median yellow bands of the abdomen entire.............*rotundicornis* Loew.
Median yellow bands broadly interrupted in the middle...*calinus*, new species.
4.—Sides of the mesonotum broadly yellow on the whole length................5.
Sides of the mesonotum not yellow on the whole length..................10.
5.—Abdomen with four pairs of very large yellow spots......................11.
Abdomen fasciate, the fasciae entire..................................6.
6.—Front of the female black on the whole length; male with a black supra-antennal spot....................................*varipes* Curran.
Front of female yellow on lower third or more; frontal triangle of the male wholly yellow......................................*pfeifferi* Bigot.
7.—Scutellum with a transverse black spot on the disc.............*feae* Bezzi.
Scutellum wholly yellow on the disc or with a narrow longitudinal triangle..8.
8.—Antennae black, the third segment sometimes broadly reddish below........9.
Antennae mostly yellowish................................*redivivus* Bezzi.
9.—Black facial vitta reaching the antennae.................*cinctifacies* Speiser.
Facial vitta abbreviated above (Syrphus?)............*intersectus* Wiedemann.
10.—Disc of scutellum with distinct, broad, transverse brown band.*schultzianus* Bezzi.
Scutellum wholly yellow...............................*trisectus* Loew.

11.—Frontal lunule with black spot in the middle............*calopoides*, new species.
Frontal lunule wholly yellow..............................*calopus* Loew.

Syrphus rotundicornis Loew

Loew, 1857, Ofv. Kongl. Vet. Akad. Förh., XIV, p. 379.
Loew, 1858, 'Dipt. Fauna Sud-Afrik.,' p. 308.

Two males and four females, Johannesburg, May, 1906; female, Basutoland.

This species has been placed in *Xanthogramma* by Bezzi. I suspect that *Syrphus dentatus* Walker described from "Cape" in 1852 is the same.

Syrphus calopoides, new species

Related to *calopus* Loew, but more robust and with a median black spot on the supra-antennal lunula. Abdomen with four pairs of large, oval, yellowish spots. Length, 9 mm.

Male.—Face, cheeks and front reddish yellow, the upper two-thirds of the front opaque, the cheeks whitish pollinose posteriorly. Front moderately large, with a roundish black spot on the lunula. Vertical triangle black, with thin brownish pollen. Occiput black, cinereous white pollinose. Pile yellowish, black on the frontal and vertical triangles and on the sides of the facial tubercle. Face slightly receding, the tubercle large, but rather low. Antennae reddish, the third segment brown on the upper apical half; arista brown, reddish basally. Eyes bare.

Mesonotum shining greenish black, the sides broadly reddish yellow; propleura, posterior half of the mesopleura and a broad band extending over the upper border of the sternopleura to the metapleura, reddish yellow, the pleura and sternum otherwise greenish black and thinly pale pollinose. Scutellum reddish yellow. Pile pale reddish yellow, black on the posterior third of the mesonotum and on the scutellum.

Legs reddish yellow, the posterior tibiae, except a broad median band, their tarsi and the apical four segments of the anterior four tarsi, reddish brown. Pile black, yellow on the front tibiae and on the ventral surface of the middle pair.

Wings cinereous hyaline, the stigma pale brownish. Squamae and fringe reddish yellow. Halteres yellow.

Abdomen opaque black, with very large reddish-yellow spots, the base, lateral margins and apex shining. Sides of the first segment broadly yellow. The spots on the second segment extend from the basal fifth to the apical sixth laterally, convex in front and behind and obtusely pointed inwardly behind their middle, very broadly separated from each other and narrowly so from the lateral margins. On the third and fourth segments the spots are more oval, widest toward the front, the outer anterior corner broadly rounded; on the fifth segment the spots are broader than long, touch the base of the segment broadly toward their inner ends and reach the posterior angles rather narrowly. Pile black, yellow basally and on the yellow spots on the third and fourth segments. Genitalia mostly black, reddish below, black-haired. Venter reddish yellow and pale pilose.

Holotype.—Male, Kikuyu Escarpment, British East Africa.

Syrphus calinus, new species

Black, the abdomen with four pairs of orange spots; face with median black or brown vitta. Length, 9 to 11 mm.

MALE.—Face, front and cheeks orange, the front opaque, the cheeks with whitish pollen posteriorly. Frontal triangle large, with a large, transverse shining black spot covering the lunula. Vertical triangle black, thinly brownish pollinose. Occiput black in ground color, grayish white pollinose. Pile black, yellow on the upper half of the occiput, white on the lower half and on the cheeks. Face slightly receding below, the tubercle large and prominent, occupying more than half the length of the face; facial vitta blackish on the tubercle, pale brown above, not reaching the oral margin. Antennae brown; third segment oval, about one-third longer than wide; arista tapering from near its base. Eyes thinly short, whitish pilose.

Mesonotum shining black, the anterior third dulled by grayish-brown pollen, the sides broadly orange in ground color on their whole length. Pleura shining blackish green, with cinereous pollen and yellow spots as follows: a large spot above the front coxae, the posterior half of the mesopleura and a broad band extending over the upper edge of the sternopleura to the metapleura. Scutellum orange, with a black spot on the basal corners. Pile reddish yellow, black behind the suture and on the scutellum, but there is some yellow pile immediately above the base of the wings. Ventral scutellar fringe black.

Legs reddish yellow, the coxae black; posterior femora black on more than the basal half, the anterior four with the bases brown; posterior tibiae reddish brown; tarsi black. Pile black, yellow on the under surface of the anterior four tibiae and no the base of the hind femora.

Wings cinereous hyaline, the stigma pale brown. Squamae pale yellowish, with brown border and fringe. Halteres reddish yellow.

Abdomen opaque black, the base, narrow lateral margins and apices of the segments shining blue-black; bearing three pairs of large, obliquely placed oval orange spots. Sides of the first segment yellow. Spots on the second segment situated about its middle, separated from each other by about the length of one spot and only slightly oblique. The spots on the third and fourth segments are situated closer to the anterior margin, are less widely separated from each other and are strongly oblique. Spots on the fifth segment touching the base broadly, their outer ends obtusely rounded. Pile black, long and yellow on the base and lateral margins and anteriorly on the third segment; black on the sides of the fourth segment apically and on all but the base of the fifth. Genitalia shining black and with black pile.

FEMALE.—Facial tubercle smaller, more nose shaped, the vitta reddish brown. Front shining black, the pale orange color extending broadly from the face to the upper third of the front; facial pile yellowish except on the sides of the tubercle. Antennae with the basal segments and the lower fourth of the third reddish. Front coxae yellow, the anterior four femora wholly pale, the posterior pair broadly yellow basally, becoming brown apically. Abdominal markings as in the male but the sides and apices of the segments more broadly shining, the pile all black beyond the basal half of the second segment.

TYPES.—Holotype, male, and allotype, female, Mount Ruwenzori, Belgian Congo, April 15 and May 18, 1914 (J. Bequaert).

Despite the differences in color of the female I believe it belongs here. However, it may prove to belong to a different species.

Syrphus calopus Loew

Loew, 1857, Ofvers. Kongl. Vet. Akad. Förhandl., XIV, p. 379.

Sixteen specimens of both sexes, Johannesburg, South Africa, February to May.

Syrphus trisectus Loew

Loew, 1857, Ofvers. Kongl. Vet. Akad. Förhandl., XIV, p. 379.

Three females, Chirinda Forest, S. Rhodesia, November, 1930 (A. Cuthbertson); male, Ngomo, Congo, February 2, 1927; female, Memeh Town, Liberia, August 29, 1926 (J. Bequaert).

Syrphus pfeifferi Bigot

Bigot, 1884, Ann. Soc. Ent. France, p. 89.

Female, Burunga, Congo; female, Rutshuru, Congo, February, 1927, and male, Reppo's Town, Liberia, September 1, 1926 (J. Bequaert); male, Basutoland (Janson).

Syrphus cinctifacies Speiser

Speiser, 1910, Kil.-Meru Exp., X, pt. 5, p. 119.

Five males and twenty females, Wagira, Gara Mulata, Abyssinia (G. Kristensen).

Speiser described only the male and his description needs amplification. The black facial vitta is variable in width but seldom occupies less than the median third of the face; the third antennal segment is broadly reddish below; the humeri and a contiguous triangular spot are yellow; the scutellum is yellow with the border black except apically, there may be a poorly defined narrow blackish triangle basally in the middle and the hair on the disc is sometimes yellowish or reddish; the abdominal fasciae may be entire, partly interrupted or very narrowly interrupted in the middle.

In the female the facial vitta usually occupies a little less than the median third of the face and the yellow ground color extends along the orbits to the lowest third or less of the front; front shining black and wholly black haired. Legs reddish yellow, the tarsi and apical third of the posterior tibiae black. Abdomen with the base, apex, sides and apices of the intermediate segments shining black, normally bearing four pairs of narrow, transversely oblique yellow spots, but the first and fourth pairs may be absent or even all the spots missing or but poorly indicated.

In both sexes the lower part of the face is quite prominent, as in *arcticus*, and the cheeks are wholly black. The species is quite small and very suggestive of *Melanostoma*, as indicated by Speiser.

ISCHIODON SACK

I know of but one African species belonging to this genus.

Ischiodon aegyptium Wiedemann

Syrphus aegyptium WIEDEMANN, 1830, 'Ausser. Zweifl.,' II, p. 133.

Female, Chirinda Forest, S. Rhodesia, November, 1930 (A. Cuthbertson); male and female, Basutoland; male and three females, Botshabelo, near Middleburg, Transvaal, 4000 ft. (H. A. Junod); male and two females, Johannesburg.

BACCHA FABRICIUS

The number of species of *Baccha* occurring in Africa is undoubtedly large, the genus being relatively little known. The flies are easily recognized by their relatively large head and long, slender, usually spatulate abdomen.

TABLE OF SPECIES

1.—Alula fully developed.......2.
Alula absent.......*conifrons* Bezzi.
2.—Face reddish or yellowish.......3
Face black, the cheeks sometimes reddish.......8.
3.—Face without a median black vitta.......4.
Face with median black vitta.......*extranea* Bezzi.
4.—Scutellum wholly yellowish.......6.
Scutellum mostly or wholly black.......5
5.—Scutellum wholly black.......*neavei* Bezzi
Scutellum with yellow border.......*euryptera* Bezzi
6.—Alula with brown tinge or strongly brown (*superpicta* Bezzi)..*picta* Wiedemann.
Alula yellowish or hyaline.......7.
7.—Mesonotum wholly yellowish.......*grahami* Bezzi.
Mesonotum yellowish with three black stripes.......*helva* Bezzi.
8.—Wings hyaline, with the stigma and a small apical spot dark brown.......9.
Wings wholly hyaline to brownish but without sharply defined apical spot...10.
9.—Abdomen wholly black.......*sapphirina* Wiedemann.
Abdomen partly reddish.......*ichneumonea* Bezzi.
10.—Second abdominal segment much shorter than the third.......11.
Second segment as long as or longer than the third.......13.
11.—Abdomen wholly black.......12.
Abdomen with yellow markings.......*claripennis* Loew.
12.—Squamae wholly white.......*brevis* Karsch.
Squamae more than half brown, the lower lobe partly white..*bequaerti* Curran.
13.—Cheeks yellowish in front.......*marginata* Bezzi.
Cheeks blackish.......14.

14.—Wings dark brown, the posterior border narrowly paler........*inversa* Curran.
Wings at most strongly tinged with brown................................15.
15.—Anterior femora yellowish on apical half or more........................19.
Anterior femora narrowly yellowish apically..... ....16.
16.—Wings brown basally before the humeral crossvein.......................17.
Wings not darkened basally...18.
17.—Frontal triangle with yellowish-brown pollen above............*brevis* Karsch.
Frontal triangle with pearly white pollen above...............*liberia* Curran.
18.—Wings with a distinct, diffuse apical spot. ....*wainwrighti*, new species.
Wings without deeper apical infuscation... ....*nitidithorax* Curran.
19.—Wings clear hyaline, the stigma black..... ....*eclara*, new species.
Wings tinged with brown and with an apical darker spot................20.
20.—Third and seventh veins almost straight; second and third abdominal segments not broadly white-haired basally................*praeusta* Bezzi.
Third and seventh veins strongly curved; second and third segments very broadly white-haired basally..................*cuthbertsoni*, new species.

Baccha picta Wiedemann

Wiedemann, 1830, 'Ausser. Zweifl.,' II, p. 93.
Baccha picta superpicta Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 43 (f).

Male, Djambi, Congo, December 23, 1913 (Bequaert); female, Lukulela, Congo, December 21, 1930 (Chapin); female, Kolobamu, Liberia, October 19, 1926, and female, Monrovia, Liberia (Bequaert).

The two females from Liberia represent the form described by Bezzi as variety *superpicta* but I doubt if a name should be given it as the Lukulela female is intermediate between this and the typical form.

Baccha grahami Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 43 (f).

Male, Paiata, Liberia, October, 1926.

This specimen agrees with the description of the type, a female, but the fifth abdominal segment is wholly black.

Baccha sapphirina Wiedemann

Wiedemann, 1830, 'Ausser. Zweifl.,' II, p. 96.

Male and female, Bulawayo, S. Rhodesia, May 1, 1927 (R. H. R. Stevenson); male and four females, Lourenço Marques, January–March, 1914; three females, Botshabelo, near Middleburg, Transvaal, 4000 ft. (H. A. Junod).

Baccha brevis Karsch

Karsch, 1887, Ent. Nach., XIII, p. 97.

Male and two females from Lukulela, December 16, 21, 1930, and January 13, 1931 (Chapin).

Baccha bequaerti Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 10.

The type is a male from Eden, Cameroon (Bequaert).

Baccha inversa Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 8.

The type female is from Lesse, Congo, July 21, 1924 (Bequaert).

Baccha nitidithorax Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 9.

The type male is from Lesse, Congo, July 21, 1924 (Bequaert).

Baccha liberia Curran

Curran, 1929, Amer. Mus. Novit., No. 340, p. 9.

Described from a male from Memeh Town, Liberia, August 29, 1926 (Bequaert).

Baccha neavei Bezzi

Bezzi, 1915, 'Syrph. Ethiop. Reg.,' p. 46.

Male, Kowie, Cape Colony, November 29, 1896 (Dr. Penther); male, Mikindani, German East Africa, 1897 (Reimer).

Baccha wainwrighti, new species

Black, the antennae and legs in part reddish; wings pale brown with dark apical spot. Length, about 9 mm.

Male.—Head black, the face and cheeks steel-blue, the occiput and broad sides and upper third of the face whitish pollinose, the frontal triangle with a very small triangle of whitish pollen above. Frontal triangle rather large and quite prominent, black pilose on the sides and above, the convex portion bare. Vertical triangle moderately long and narrow, with a median row of black pile, that on the ocellar triangle white. Occiput with white pile but toward the vertex there are a number of subsquamose black cilia. Oral margin strongly oblique, convex anteriorly, concave in the middle. Face perpendicular, with a moderately large tubercle on the lower half; short, white pilose. Antennae reddish, the third segment obliquely brown on the upper half, a little less than twice as long as wide, its apex evenly rounded; arista brown, reddish on the thickened basal portion.

Thorax shining black, more or less bronzed; pile pale brownish yellow on the pleura and on the sides of the mesonotum anteriorly, black on the mesonotum but there is a broad median band of pale yellowish hair extending forward from the scutellum almost to the anterior margin, and the "collar" is obscure yellowish. Scutellar pile yellowish, the long marginal hairs black, the ventral fringe pale.

Legs black or brown, the tips of the femora, bases of the tibiae and the tips of the anterior four, the anterior four tarsi and the basal segment of the hind pair, reddish yellow, the anterior four femora with reddish base; anterior four tibiae rather brownish red rather than brown. Pile short and inconspicuous except on the posterior surface of the middle femora, where it is long and black.

Wings pale brownish, the stigma and the subtriangular preapical spot dark brown. Squamae brownish. Halteres yellow, darker in front.

Abdomen shining bronze black, with opaque markings, strongly pedicellate, the second segment narrowed from the base to the basal fourth, thence with almost parallel sides to the apex, the third widening from base to apex where it is about four times its basal width, the fourth gently narrowing apically, longer than wide, the fifth twice as wide as long. Second segment with an incomplete, preapical opaque fascia, the third subopaque on the posterior half except laterally, the fourth with an incomplete, subopaque band across the middle the apical half and the fifth segment not metallic. Pile black, white on the first segment, on the sides of the third, where it extends entirely across the broad base, and on the anterior angles of the fourth. Genitalia shining bluish black and black-haired.

HOLOTYPE.—Male, Lourenço Marques, January-March, 1914 (H. A. Junod), received from Mr. Colbran J. Wainwright.

Baccha cuthbertsoni, new species

Black, the legs mostly reddish; wings tinged with brown except basally and with trace of preapical brown spot. Length, about 9 mm.

MALE.—Head metallic blackish blue in ground color, the frontal and vertical triangles shining black; pile black, pale yellow on the occiput, the upper occipital cilia brownish yellow. Frontal triangle rather small, moderately convex, the sides and upper border with pile, the middle bare, a very small spot of cinereous pollen above. Vertical triangle elongate and narrow, the row of hair wholly black. Occiput and face cinereous white pollinose. Oral margin strongly oblique. Face perpendicular, the tubercle of medium size and more prominent than the antennal base, shining black. Antennae reddish, the third segment slightly darkened above, one-half longer than wide, subcylindrical, the apex broadly rounded; arista brown on apical half.

Thorax shining black, the pleura with obscure yellowish pollen in the middle and whitish pollen on blackish-blue ground posteriorly. Pile yellowish, black behind the suture except in the middle, very pale on the pleura.

Legs reddish, the coxae, posterior femora except the ends and the posterior tibiae on the apical three-fourths, brown. Pile inconspicuous, pale, mostly black on the posterior femora and tibiae, long and blackish posteriorly on the middle femora.

Wings tinged with brown on the apical two-thirds, the stigma dark brown. Between the tips of the second and third veins there is a narrow brown spot along the costa that quickly merges into the pale field. Squamae and fringe white. Halteres pale yellow.

Abdomen shining black, with opaque markings, the sides of the first segment somewhat bluish. Sides of the second segment narrowed to the basal fourth, thence with parallel sides to the apical fourth which is slightly swollen and bears an incomplete opaque fascia; third segment decidedly longer than wide, increasing in width from the base to apex; fourth segment longer than wide and gently tapering apically; fifth segment three times as wide as long. Third segment with a large opaque triangle occupying the apical half except laterally, the fourth with a large, subopaque triangle extending forward from the apical fourth almost to the base, the fifth with the broad apex bronzed. Pile black, obscure yellowish on the basal two segments, whitish on the sides and broad base of the third, the fourth with a broad basal fascia of appressed, sparse, white pile that is greatly expanded inside the lateral margins but does not reach the sides. Genitalia shining black. Venter bluish, with broad, opaque bands on the apices of the sternites.

HOLOTYPE.—Male, Lourenço Marques, April–July, 1914 (H. A. Junod), received from Mr. Colbran J. Wainwright.

Baccha eclara, new species

Black and metallic bluish; wings hyaline; fifth abdominal segment wholly white haired. Length, 8.5 to 10 mm.

MALE.—Head blue-black, wholly white pilose; cinereous white pollinose, the frontal triangle except along the narrow orbits and above, the vertical triangle and a quadrate spot covering the tubercle, shining black. Frontal triangle only gently convex and with a rather small non-pilose area; pile of vertical triangle in a median row. Sides of face thickly pollinose; anterior oral margin as prominent as the antennal base. the tubercle moderately small, rather sharply rounded. Antennae reddish, the third segment darkened above and apically, one-half longer than wide, subcylindrical, the end moderately sharply rounded; arista brown, with reddish base.

Thorax shining black, the pleura mostly bluish, with thin cinereous pollen. Pile wholly whitish.

Legs reddish yellow, the basal third of the front, half of the middle and all but the tip of the posterior femora brown; posterior tibiae brown on apical two-thirds; posterior tarsi becoming brownish red apically. Pile wholly whitish.

Wings hyaline; stigma brown. Squamae white. Halteres yellow.

Abdomen as in *cuthbertsoni* except that there is no opaque area on the fourth segment and the fifth segment and genitalia are entirely white pilose.

FEMALE.—Front moderately wide, below the middle with a broad band of ashy-white pollen; ocellar triangle as wide as long. Pollen on pleura moderately thick. The white pilose fascia on the fourth abdominal segment occupies the basal half of the segment laterally, is somewhat restricted in the middle and does not reach to the lateral margins on the basal fifth of the segment; the white pile of the fifth segment extends forward onto the disc of the fourth in the middle.

TYPES.—Holotype, male, allotype, female, paratypes, two males and two females, Lourenço Marques, January–March, 1914 (H. A. Junod). Types returned to Mr. Colbran J. Wainwright. Paratypes in Museum collection.

MELANOSTOMA SCHINER

Due to the fact that some of the species of *Melanostoma* are somewhat variable in coloration it is not possible to give a thorough revision of the species at this time. In order to clear up the identity of the various forms known from Africa it will be necessary to have a large amount of material. The key contains those species that I have been able to recognize in the available material.

TABLE OF SPECIES

1.—Antennae wholly black.................................*infuscatum* Becker.
Antennae extensively reddish or yellowish.................................2.

2.—Legs entirely yellow...3.
Legs with black bands or posterior tarsi black..............................4.
3.—Facial tubercle low and completely divided in the middle...*bituberculatum* Loew.
Facial tubercle normal, moderately prominent..............*floripeta* Speiser.
4.—First segment of posterior tarsi usually yellow or reddish, if not the second abdominal segment wholly black....................................5.
Posterior tarsi brownish, practically uniform in color, the second abdominal segment with pale spots..8.
5.—Second abdominal segment with yellow spots or markings..................6.
Second segment wholly black...9.
6.—Yellow abdominal markings divided longitudinally by black vitta............7.
Yellow markings not interrupted.......................*pyrophaenoides* Speiser.
7.—Squamae of male with brownish border; spots on second abdominal segment small, roundish, especially small in female..............*automenes* Walker.
Squamae with yellow border; spots on second segment subrectangular, fairly large in both sexes..............................*annulipes* Macquart.
8.—First segment of the posterior tarsi with yellowish or tawny hair above or it appears so from basal view........................*scalare* Fabricius.
Basal segment of posterior tarsi with black hair above....................sp.
9.—Posterior femora blackish except the base and apex.....................sp.
Posterior femora reddish on more than the basal half........*gymnocera* Bigot.

Melanostoma annulipes Macquart

Syrphus annulipes Macquart, 'Dipt. Exot.,' II, part 2, p. 102 (f).

Male and female, Boswenda, Congo, October 10, 1914; female, Tshumbiri, Congo, December 14, 1926; male and female, Du River Camp No. 3, Liberia, 1926; male, Reppo's Town, Liberia, September, 1926 (J. Bequaert).

Melanostoma automenes Walker

Syrphus automenes Walker, 1849, 'List. Dipt. Brit. Mus.,' III, p. 589.

Male, Ngomo, Congo, February 2, 1927 (J. Bequaert); female, Bunnga, Uganda, June 6, 1926.

Melanostoma infuscatum Becker

Becker, 1910, Ann. Soc. Ent. France, p. 26.

Two males, Mt. Ruwenzori, Congo, May 18, 1914; male and five females, Burunga, Congo (J. Bequaert).

Melanostoma gymnocera Bigot

Bigot, 1891, Ann. Soc. Ent. France, p. 375.

Three males, Ukaika, December, 1910 (Grauer).

In his work on the African Syrphidae Bezzi placed *gymnocera* as a synonym of *mauritiana* Bigot, despite the statement of Bigot that the latter bears two pale spots on the second abdominal segment, these being absent in *gymnocera*. The male of *gymnocera* superficially resembles *infuscatum* Becker but differs in having the antennae mostly reddish and with much longer third segment, and, of course, reddish anterior femora.

Melanostoma bituberculatum Loew

Syrphus bituberculatum Loew, 1859, Ofvers. Kongl. Vet. Akad. Förhandl., XIV, p. 379.

Male and female, Wagira, Gara Mulata, Abyssinia (G. Kristensen); male and female, Lake Chrissie, S. E. Africa, female, Basutoland (Janson); three females, Lourenço Marques, April–July, 1914 (H. A. Junod); male, Johannesburg, 1904 (J. P. Cregoe).

XANTHANDRUS VERRALL

Verrall, 1901, British Flies, VIII, p. 316.

This genus has not been recorded from the Ethiopian Region although a species has been described from Madeira by Bigot. The following table separates the Palaearctic and African forms.

1.—Mesonotum shining, pollinose only on the broad sides in front...............2.
Mesonotum pollinose in front of the suture and before the scutellum..........
....*congensis*, new species.
2.—Face black haired and thinly pollinose...................*hyalinatus* Bigot.
Face cinereous pilose and pollinose..........................*comtus* Harris.

Xanthandrus congensis, new species

Black, the legs mostly reddish, the abdomen with reddish markings. Length, 11 mm.

Female.—Head black in ground color, the front with a large, convex area immediately above the antennae reddish. Front shining, densely ochraceous pollinose below the middle and along the orbits opposite the antennal tubercle, metallic bluish immediately below the pollinose fascia, in front of the ocellar triangle with a large, prominent swelling extending almost from side to side; vertical tubercle distinctly swollen, the ocellar triangle wider than long. Occiput cinereous yellow pollinose, the cheeks pale. Face with thick ochraceous pollen, the tubercle round and shining black. Antennae brownish red, the arista black on the apical half; third segment brown, about three times as long as wide, somewhat longer than the second segment. Pile very short, brassy yellow, black on the upper half of the front.

Thorax aeneous in ground color, the pleura whitish pollinose; mesonotum with a broad posterior band of dense ochraceous pollen, and with paler pollen laterally in front of the suture, in the middle in front of the suture with thin brownish-yellow pollen. Pile very short, brassy yellow dorsally, white on the pleura, a broad band behind the suture mixed black and yellow. Scutellum large, distinctly margined. Mesonotum and scutellum with tiny tubercles, those on the margin of the scutellum conspicuous.

Legs rusty reddish, the tarsi blackish above; basal half of anterior four tibiae yellow, the trochanters and immediate bases of the femora reddish yellow, the posterior tibiae reddish brown. Anterior tarsi distinctly broadened.

Wings hyaline, the stigma luteous. Squamae white, broadly yellow apically. Halteres reddish yellow.

Abdomen black, the sides and apex shining. First segment and a large, hemispherical spot on the second that is produced broadly to the lateral margins basally, dull orange; third segment with an incomplete orange fascia that is widest in the middle and tapers to the rounded ends, narrowly separated from the base of the segment and broadly so from the lateral margins. The black of the second and third segments is opaque, the fourth is subopaque although this segment appears to be mostly shining in some lights. Pile very short and black, yellowish only on the broad base of the abdomen. Venter reddish.

HOLOTYPE.—Female, Lukolela, Belgian Congo, December 16, 1930 (J. P. Chapin).

PARAGUS LATREILLE

This genus is represented in Africa by seven species separable by the following key. Owing to the great variation in the color of the abdomen of some of the representatives of the genus a number of varietal names have been applied but these should be ignored. Some are based upon color characters that are sexual while others apply to individuals having a rather distinctive color pattern.

TABLE OF SPECIES

1.—Scutellum wholly black.......................3
Scutellum broadly yellow apically.......................2.
2. -Apex of the scutellum crenulate.......................*serratus* Fabricius.
Scutellum without teeth.......................*aegyptius* Macquart.
3. --Face without a distinct tubercle, not concave between the weak tubercle and oral margin.......................4.
Face with a distinct tubercle and decidedly concave above the oral margin.......................*tibialis* Fallen.
4. Abdomen wholly black, rarely with reddish apex.......................5.
Abdomen with the disc broadly yellow, the second segment as wide as the third.......................*borbonicus* Macquart.
5. -All the femora black basally.......................6.
Anterior four femora wholly yellow.......................*dolichocerus* Bezzi.
6. Second abdominal segment in both sexes wider than long, in the female very much wider than long.......................*marshalli* Bezzi.
Second abdominal segment in the male much longer than wide, in the female at most as wide as long.......................*longiventris* Loew.

Paragus tibialis Fallen

Pipiza tibialis FALLEN, 1817, 'Dipt. Suec., Syrph.,' p. 60.

Two males and one female from Johannesburg, South Africa; female, Basutoland; female, Salisbury, Southern Rhodesia, May 1, 1927 (A. Cuthbertson).

Paragus serratus Fabricius

Mulio serratus FABRICIUS, 1805, 'Syst. Antl.,' p. 186.

Male, Lourenço Marques, April–July, 1914 (H. A. Junod).

Paragus borbonicus Macquart

MACQUART, 1842, 'Dipt. Exot.,' II, part 2, p. 106 (f).

Male, Beni, Congo, May 1, 1914; male, Lesse, Congo, July 21, 1914; female, Stanleyville, April 11, 1915; male, Lubutu, Congo, February 6, 1915; two males, Du River Camp No. 3, Liberia, 1926; male, Memeh Town, Liberia, August 29, 1926; male and female, Kakatown, Liberia, August 20, 1926 (J. Bequaert); five males, Lourenço Marques, 1914 (H. A. Junod); two males, Salisbury, Southern Rhodesia, January 20, 1935, and March 24, 1931; male, Bala Bala, Southern Rhodesia, March, 1931, and female, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson).

Paragus marshalli Bezzi

BEZZI, 1915, 'Syrph. Ethiop. Reg.,' p. 13, (f).

Male and female, Memeh Town, Liberia, August 25, 29, 1926; male Reppo's Town, Liberia, September 1, 1926.

Paragus longiventris Loew

LOEW, 1857, Ofvers. Kongl. Vet. Akad. Förhandl., XIV, p. 376.

Male and female, Gbanga, Liberia, September, 1926; male, Lenga Town, Liberia, August, 1926; female, Reppo's Town, Liberia, September, 1926 (J. Bequaert); male, Wagira, Gara Mulata, Abyssinia (G. Kristensen).

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NEW SPECIES OF ROTIFERA FROM THE COLLECTION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

BY FRANK J. MYERS

The collection of Rotifera in the cabinet of The American Museum of Natural History consists, at this writing, of 1009 slides of various species and varieties, which include 111 slides of various trophi and 190 types, spread among 105 genera.

Emphasis has been placed on trophi slides, due to their importance in classification. It is possible to identify many species by an examination of the jaws alone. This is very necessary when it comes to listing illoricated species contained in collections, made in the field, wherein the rotifers have been killed and fixed in a solution of formalin or alcohol without previous narcotization.

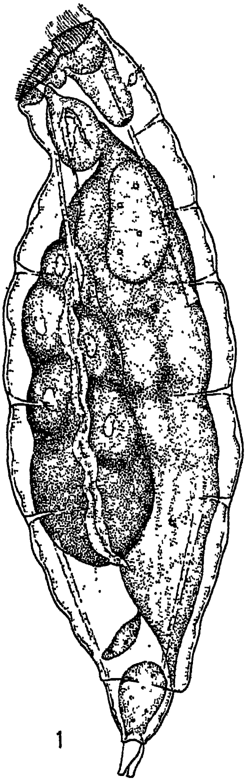
The great majority of rotifers in the collection are mounted in glycerin or glycerin jelly. In only a few very difficult cases has resort been made to 2 per cent formalin, although it is possible to make permanent mounts using that medium.

From time to time slides of undescribed species have been placed in the collection as a safe depository. These have accumulated, so there are now 11 new species and 3 varieties.

The new species and new varieties described in this paper are as follows:

Proales segnis
Lindia gracilis
Notommata cherada
Dicranophorus lenapensis
Lecane pustulosa
Filinia camasecla
Euchlanis dilatata crassa
Dicranophorus spiculatus
Squatinella retrospina
Trichocerca plaka
Trichotria cornuta
Lepadella pyriformis
Keratella cochlearis taurocephala
Keratella cochlearis punctata

No attempt has been made to draw the various species to scale. Some would be so large that, in order to include the smaller ones within the limits of an octavo page, necessary detail could not be reproduced. For actual measurements the reader is referred to the text.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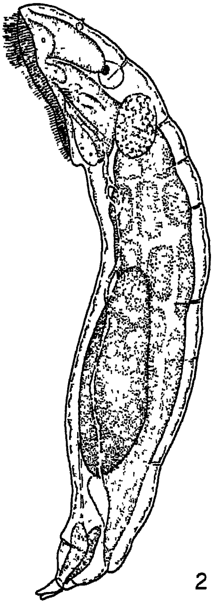
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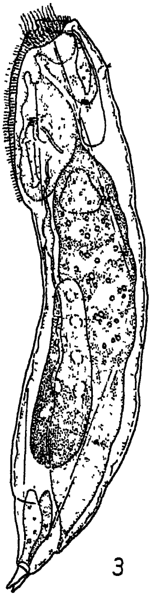
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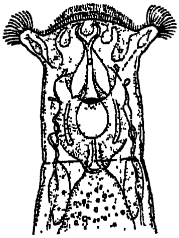
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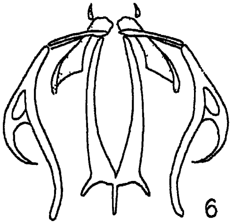
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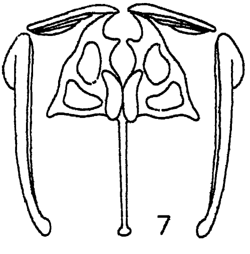
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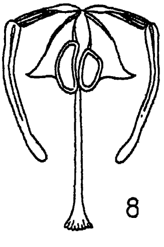
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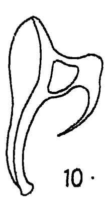
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2

ORDER MONOGONONTA

Family **Notommatidae**

Proales segnis, new species

Figures 1, 4, 7, 11, 12, 15, 16

The body is cylindric, swollen, and very stout. The integument is soft and flexible, so that the outline constantly changes with the incessant contortions of the individual.

The head is relatively small, and the neck is represented by an indistinct fold. The abdomen is elongate oval and relatively very large. The tail is evanescent and the foot is small and stout, consisting of but one joint. The toes are very short, triangular, and have truncate tips. In dorsal aspect, they are enlarged at the base, then diminish gradually, ending in pinched-in tips.

The dorsal and lateral antennae are normal.

The corona is small and oblique, exhibiting the ciliation normal to the genus.

The mastax is of modified malleate type. The fulcrum is longer than usual, slender, and straight. The rami are broad and triangular and have a large basal apophysis; the median opening is lyrate and each ramus has a prominent, opposing tooth situated at about mid-length. Each uncus has four slender teeth, clubbed at the tips, which gradually decrease in size from the ventral margin. The base of the uncus is produced as a slender, curved reinforcement ridge resting against the dorsal tooth. The median branch of the manubrium is long and slender, having the usual sigmoidal curvature; the ventral branch is nearly as long as the median, while the dorsal branch is very short.

The oesophagus is short. The gastric glands are very large and oval. There is no constriction between the stomach and the intestine, which has a glandular caecum attached to the ventral side near the posterior extremity. The nuclei of the ovary are large and appear to have separate yolk masses. There is no bladder. The foot glands are short and very stout, completely filling the foot.

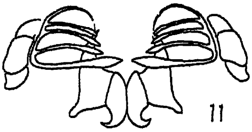
The ganglion is relatively small, and the minute eyespot is situated at its posterior end. No retrocerebral organ is present.

Total length, 1050μ; toes, 50μ; trophi, 55μ.

HABITAT.—Among *Utricularia*, Parvin State Park, Cumberland County, New Jersey.

Proales segnis is a bottom sprawler. On account of its huge bulk, the

Fig. 1. *Proales segnis*, lateral view.
Fig. 2. *Lindia gracilis*, lateral view.
Fig. 3. *Notommata cherada*, lateral view.
Fig. 4. *Proales segnis*, toes, dorsal view.
Fig. 5. *Notommata cherada*, head, dorsal view.
Fig. 6. *Lindia gracilis*, trophi, ventral view.
Fig. 7. *Proales segnis*, trophi, ventral view.
Fig. 8. *Notommata cherada*, trophi, ventral view.
Fig. 9. *Lindia gracilis*, uncus, frontal view.
Fig. 10. *Lindia gracilis*, manubrium, lateral view.



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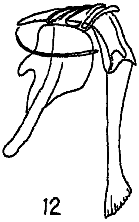

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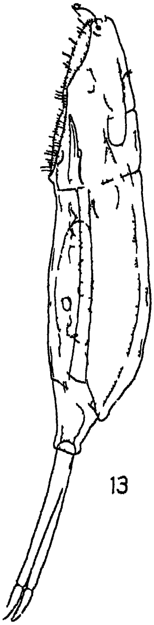

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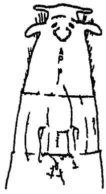

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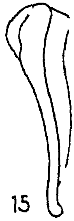

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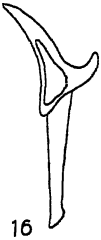

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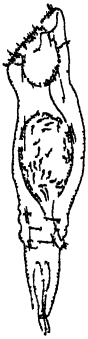

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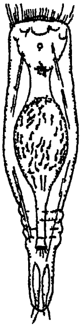

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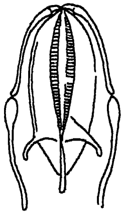

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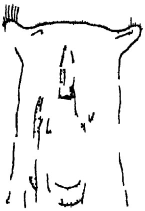

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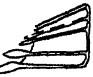

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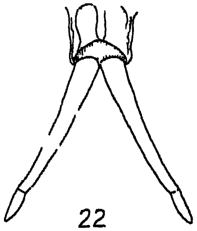

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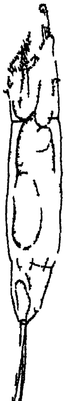

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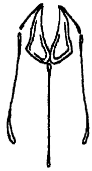

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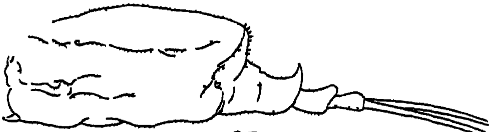

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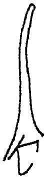

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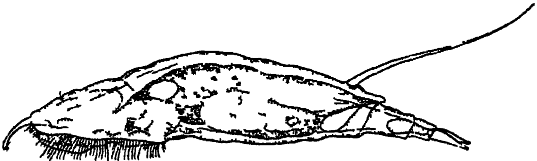

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great size of the abdomen, and the relatively small size of the corona, it seems to have very feeble powers of locomotion. The abdominal gland is unique in this genus. While several rotifers, such as *Enteroplea lacustris* (Ehrenberg) and *Epiphanes clavulata* (Ehrenberg) have caeca-like appendages attached to the stomach, they evidently perform a gastric function while, in this case, the function is probably extra-assimilative, as are those of *Voronkowia miriabilis* Fadeew, which has four.

Proales segnis is so large and distinctive that there is no possible chance of confusing it with any other species of the genus.

Type in The American Museum of Natural History. Cat. No. 918.

Lindia gracilis, new species

Figures 2, 6, 9, 10, 26

The body is slender, elongate, and vermiform. The integument is soft and very flexible. It has a number of obscure transverse folds, giving it an annular appearance.

The head is rather small and the neck segment is indistinct. The abdomen is nearly cylindric and tapers very gradually to the small tail. The foot is short, stout, and triangular. The toes are short, conical, and slightly compressed at the blunt tips.

The dorsal and lateral antennae are normal.

The corona is prone and extends down the ventral side about one-fourth the length of the body; the auricles are small and of the usual type.

The mastax is of the cardate type and is provided with a pair of confluent salivary glands lying in the lateral angles. The rami are lyrate and exceptionally long and slender. The fulcrum is extremely short. The unci have one functional and one rudimentary tooth; the ventral tooth is slightly clubbed and hooked at the tip, while the dorsal rudimentary is a short straight rod resting against the ventral tooth near the tip. The manubria are of the normal form, with a large, crescent-shaped anterior

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Fig. 11. *Proales segnis*, trophi, frontal view.
Fig. 12. *Proales segnis*, trophi, lateral view.
Fig. 13. *Dicranophorus lenapensis*, lateral view.
Fig. 14. *Dicranophorus lenapensis*, head, dorsal view.
Fig. 15. *Proales segnis*, manubrium, lateral view.
Fig. 16. *Proales segnis*, incus, lateral view.
Fig. 17. *Notommata cherada*, male, lateral view.
Fig. 18. *Notommata cherada*, male, dorsal view.
Fig. 19. *Dicranophorus lenapensis*, trophi, ventral view.
Fig. 20. *Notommata diasema*, head, dorsal view.
Fig. 21. *Notommata cherada*, uncus.
Fig. 22. *Dicranophorus lenapensis*, toes, dorsal view.
Fig. 23. *Dicranophorus spiculatus*, lateral view.
Fig. 24. *Dicranophorus spiculatus*, trophi, ventral view.
Fig. 25. *Trichotria cornuta*, lorica, lateral view.
Fig. 26. *Lindia gracilis*, incus, lateral view.
Fig. 27. *Squatinella retrospina*, lateral view.

branch forming an approximate right angle with the median branch which is rather slender, sigmoidal, and decurved; the dorsal branch is nearly as long as the median. The epipharynx consists of two thin, lamellar pieces meeting below the mouth. The anterior portion is hammer-like, while the posterior portion is expanded into two broadly curved, triangular plates.

The oesophagus is very short. The gastric glands are large and vacuolated. There is no separation between the stomach and the intestine. The bladder is small, while the ovary is of the normal elongate form and rather large. The foot glands are quite long and slender.

The ganglion is normal. The retrocerebral organ is reduced to a ductless sac enclosing the eyespot which is filled with red pigment granules.

Total length, 250μ; toes, 10; trophi, 40μ.

HABITAT.—Among submerged aquatics, Pleasant Mills, Atlantic County, New Jersey.

Lindia gracilis bears a superficial resemblance to the other members of the genus. It differs from all of them in the elements of the trophi, especially by the extremely slender, drawn out rami and the much reduced fulcrum.

Type in The American Museum of Natural History. Cat. No. 918.

Notommata cherada, new species

Figures 3, 5, 8, 17, 18, 21

The body is elongate and vermiform. The integument is very flexible, but the outline remains quite constant in the adults.

The transverse fold limiting the neck segment is indistinct. The abdomen is almost parallel-sided; it falls away posteriorly, and ends with hardly any indication of a tail. The foot is stout and obscurely two-jointed. The toes are conical and end abruptly in minute papillose tips. In dorsal aspect, they are close together and somewhat bulbous at the base.

The corona is prone and extends down the ventral side about one-third the length of the body. The auricles are small and the ciliation is continuous with the corona.

The dorsal and lateral antennae are normal.

The mastax is of the virgate type. The fulcrum is long and expanded at the posterior end which is serrate. The rami are roughly triangular and without inner denticulation; the basal apophysis of the right ramus is somewhat larger than that of the left. The unci are symmetric and each has four slender, diminishing teeth clubbed at the tips, followed by two parallel rudimentary teeth. The manubria are somewhat incurved and have a broad, sub-square basal plate. Each dorsal cell has a decurved lobelike projection near the middle of the margin. A pair of curved supporting rods is imbedded in the walls of the mastax behind the posterior margins of the dorsal branch of the rami.

The oesophagus is very short. The gastric glands are large and triangular. The ovary is rather large, and there is no bladder, the cloaca functioning instead. There is no distinct separation between the stomach and the intestine. The foot glands are large and pyriform.

The retrocerebral sac is clear, large, and rounded; the duct is stout and can easily be traced to the outlets on the apical area, which, in this case, is situated low down and is surmounted by a prominent cuticular fold. The sub-cerebral glands are equal to one-half the length of the sac. The ganglion is large and has a round eyespot attached to the posterior end.

Total length, 275–335μ; toes, 12–15μ; trophi, 40μ.

HABITAT.—Among submerged aquatics, Bargaintown, Atlantic County, New Jersey.

Males seemed to be common (Figs. 17–18). The posterior portion of the abdomen is wrinkled, and the foot is long and cylindrical, terminated by two short toes. The ganglion is large. There are remnants of a retrocerebral sac and duct, and the eyespot consists of a rather dense cluster of bacterioids at the posterior end of the ganglion.

The alimentary tract is represented by the usual connecting band between the testis and the corona. There is no bladder. The testis is large and oval; the ductus seminalis is strongly ciliated, and the opening for the copulatory organ is situated at the junction of the striated area of the abdomen and the base of the foot.

Total length, 150μ.

Notommata cherada belongs to that group of notommatid rotifers of similar body shape, having the retrocerebral glands equal to about one-half the length of the sac; such as, *Notommata cerberus* (Gosse), *N. galena* Harring and Myers, *N. thopica* Harring and Myers, *N. codonella* Harring and Myers and *N. parvida* Myers. These species are best differentiated by a comparison of the toes and trophi. Although innumerable collections have been at Bargaintown over a period of years, this species was not met with until the spring of 1937. In young specimens the general shape is quite changeable, frequently resembling that of the male, as shown in lateral aspect in figure 17.

Type in The American Museum of Natural History. Cat. No. 952.

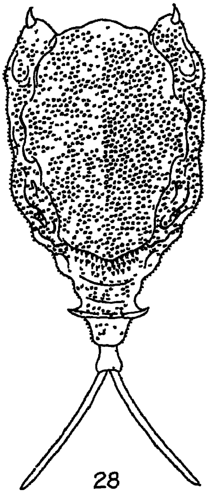
Trichocerca plaka, new species

Figures 30, 31, 33

The body is short, stout, and rounded posteriorly. The head sheath is not very distinctly set off from the abdomen; it is provided with two mucrones, the right being long, triangular, and acute, whilst the left is very short. A low ridge arises at the base of the larger mucro, and the striated area extends down the body for about two-thirds of its length. The foot is rudimentary and ventrally placed. The right toe is about two-thirds the length of the left, and there are a few minute substyles clustered about their bases.

The dorsal and lateral antennae are in the usual positions.

The mastax is of the modified virgate type peculiar to the genus, and the trophi are simple and small. The fulcrum is a long, lamellar plate, expanded posteriorly. The rami are triangular and the alulae are prominent, the left being much larger than the right. The right uncus is provided with a single very slender tooth, whilst that



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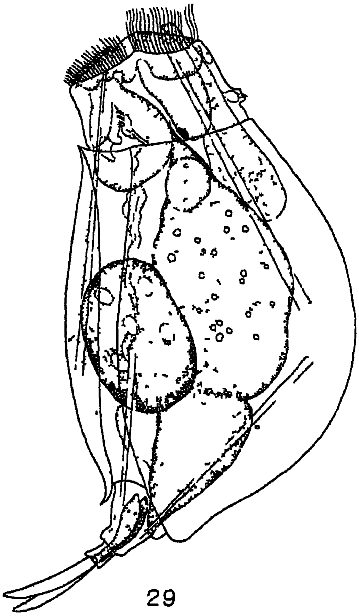

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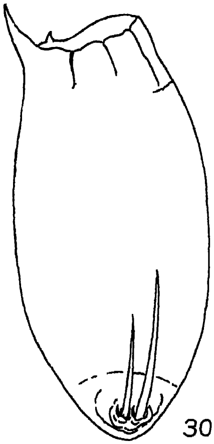

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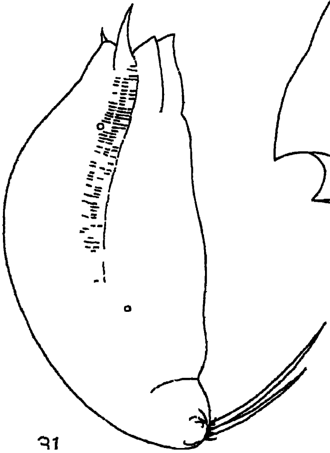

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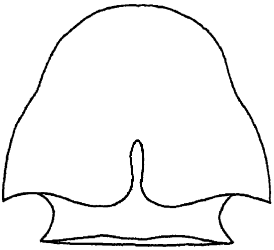

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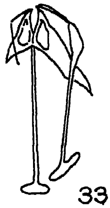

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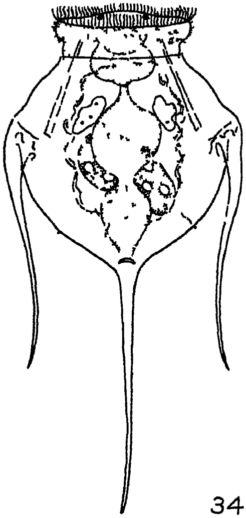

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Fig. 28. *Trichotria cornuta*, lorica, dorsal view.
Fig. 29. *Euchlanis dilatata crassa*, lateral view.
Fig. 30. *Trichocerca plaka*, lorica, ventral view.
Fig. 31. *Trichocerca plaka*, lorica, dorsal view.
Fig. 32. *Euchlanis dilatata crassa*, lorica, cross-section.
Fig. 33. *Trichocerca plaka*, trophi, ventral view.
Fig. 34. *Filinia camasecla*, dorsal view.

of the left uncus is longer and stouter. The right manubrium is short, slender, and rudimentary; the left is very long, expanded at the base, and strongly crutched distally.

Length of lorica from tip of longer mucro, 116μ; left toe, 36μ; right toe, 20μ.

HABITAT.—Submerged *Sphagnum* in acid water, Atlantic County, New Jersey.

Trichocera plaka resembles *Trichocerca* (*Diurella*) *tenuidens* (Hauer). It differs in being much smaller, by the evanescent foot, in the proportion of the toes, and by having two frontal mucrones instead of one.

Type in The American Museum of Natural History. Cat. No. 954.

Family **Dicranophoridae**

Dicranophorus lenapensis, new species

Figures 13, 14, 19, 22

The body is fusiform, rather stout, somewhat convex dorsally, and nearly straight ventrally. The integument is somewhat stiffened and the outline is constant.

The head is about one-third the length of the body, and is separated from the abdomen by a well-marked neck constriction. The corona is ventral, of about the same length as the head, and has prominent lateral, auricle-like tufts of long cilia adapted for locomotion. The rostrum is long and strongly decurved; dorsally, it has two laterally projecting lappets and at its base are two slender, tactile pseudopods. The abdomen is relatively short and tapers posteriorly to the minute tail. The integument is divided by two lateral sulci into a dorsal and ventral plate. The foot is short, conical, and stout. The toes are straight and long, stout at the base, then tapering gradually and terminating in well-marked claws. In dorsal aspect, the claws do not lie in the axis of continuation indicated by the angle made by the toes, but a bending in, or change of direction occurs at their junction, so that the angle of the claws is narrower than that of the toes.

The mastax is of the forcipate type, and the trophi are robust. The rami are lyrate and obtusely pointed at the base; the inner margins are provided with a denticulate comb, consisting of about 30 fine blunt teeth. The fulcrum is very short, being only about one-eighth the length of the rami. The alulae are elongate, triangular, projecting, and decurved at the tips. The unci are very long and slender, ending in a single and slightly curved tooth, at the base of which is an enlargement resting on the rami and serving as a hinge in the movements of the trophi. The manubria are very short, about one-half the length of the incus, slightly curved, and stoutly knobbed anteriorly.

The gastric glands are small and oval. The stomach and intestine are not distinctly separated. The ovary and bladder are normal. The foot glands are short and stout.

The retrocerebral sac is rather small, and the ducts can easily be traced to the openings on the buccal field. At the base of the rostrum are two eyespots.

Total length, 350μ; toes, 90μ; trophi, 50μ.

HABITAT.—Among *Fontinalis* growing at the base of *Sparganium* stalks, Lenape Lake, Atlantic County, New Jersey.

Dicranophorus lenapensis belongs to that group of large dicranophorid rotifers which include *Dicranophorus thysanus* Harring and Myers, *D. isothes* Harring and Myers and *D. saevus* Harring and Myers, all of which are provided with tactile pseudopods. The salient differences between these are in the trophi, the number of pseudopods, and the relative length of the toes. The toes of *D. thysanus* and *D. isothes* are relatively short and without claws; the former has three and the latter has two tactile pseudopods, while the trophi are very different from each other or any others of the group. *Dicranophorus saevus* has one tactile pseudopod, while the toes are very long and provided with claws. The fulcrum of *D. lenapensis* is the shortest, relatively, of any species of the genus.

Type in The American Museum of Natural History. Cat. Nos. 892, 893.

Dicranophorus spiculatus, new species

Figures 23, 24

The body of this small species is elongate, very slender, cylindric, and almost parallel-sided; the integument is quite stiff and the outline is very constant.

The neck is long and separated from the abdomen by a marked constriction. The corona is prolonged anteriorly into a conelike projection which is completely ciliated and continues ventrally, making the sub-prone corona nearly as long as the head. There is no rostrum present. The abdomen is elongate and tapers posteriorly to the minute tail. The foot is short and stout. The toes are long, very slender, slightly decurved, and gradually diminish in width, ending in extremely slender tips.

The mastax is of the forcipate type, and the trophi project slightly from the mouth opening. They are very small and feeble, but remarkable on account of the great length of the fulcrum in a genus wherein the fulcrum is usually short. The rami are lyrate and terminate in simple incurved tips; neither alulae nor inner marginal teeth are present. The fulcrum is about twice the length of the rami and very slender. The single-toothed unci are long and slender. The manubria are long, slender, and slightly enlarged at the posterior tips.

The stomach and intestine are without distinct separation. The ovary, gastric glands, and bladder are normal. The foot glands are quite large and pyriform.

The ganglion is very long, extending posteriorly somewhat beyond the neck constriction. There is no retrocerebral organ present. A pair of small eyespots are situated near the apex of the cone-shaped corona.

Total length, 104μ; toes, 24μ; trophi, 18μ.

HABITAT.—Among *Fontinalis* growing at the base of *Sparganium* stalks, Lenape Lake, Atlantic County, New Jersey.

Dicranophorus spiculatus is the smallest member of the genus. The corona is very characteristic. This feature, together with the long fulcrum and toes, readily distinguish it from any of the other species of the genus.

Type in The American Museum of Natural History. Cat. No. 907.

Family **Brachionidae**

Squatinella retrospina, new species

Figure 27

The body is elongate, fusiform, and fairly stout; strongly convex dorsally and straight ventrally. The integument is very flexible and the usual lorica is apparently absent. The whole animal is very transparent. The head s deflexed and separated from the abdomen by a well-marked constriction. The corona is prone, evenly and strongly ciliated, and is provided with lateral tufts of long, locomotor cilia, the whole organ resembling that of *Notommata*. The head is protected dorsally by the usual head-hood, but in this case it is much narrower than in other members of the genus. Laterally, it appears hooklike and resembles the rostrum of the dicranophorid rotifers. It is wholly anterior to the head, very transparent, and constricted at the base.

The abdomen is elongate, deepest at about one-third length, from whence it tapers gradually to the minute tail. Situated near the posterior limit of the abdomen, a short distance in front of the tail is a long, curved spine, fairly stout at the base, after which it gradually diminishes in width to an excessively slender tip. The foot is quite long, conical, and composed of two joints. The toes are short, slender, acute, and almost straight.

The mastax is of modified malleate type, and there are 7 or 8 slender teeth in each uncus.

The oesophagus is very short. The gastric glands are small and oval. The bladder and ovary are normal. The foot glands are equal in length to the toes.

The ganglion is long and saccate, and there are no eyespots.

Total length, 152μ; toes, 12μ; dorsal spine, 50μ.

HABITAT.—Among submerged *Sphagnum*, Atlantic County, New Jersey.

Squatinella retrospina, while having the same habits of locomotion as the other species of the genus, differs from all of them by the absence of a lorica, eyespots, and in the position of the dorsal spine.

Type in The American Museum of Natural History. Cat. No. 501.

Trichotria cornuta, new species

Figures 25, 28

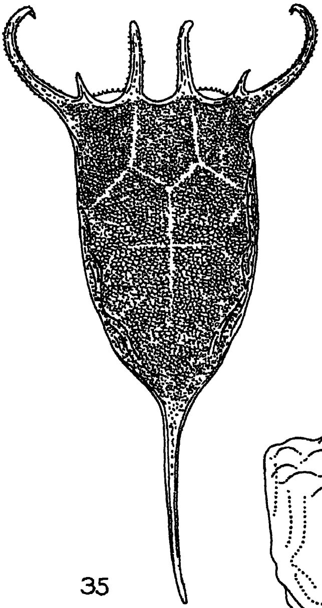
The integument is only slightly stiffened. The anterior portion is characterized by two robust spines situated at the lateral angles, very conspicuous when the rotifer is fully contracted. The entire lorica is stippled and marked by exceedingly fine areolations. The only spines present are situated at the postero-dorsal extremity of the abdomen. The last body segment is characterized by a stiff, recurved ridge extending the entire width of the posterior margin of the lorica. There are no condyles on the basal foot joint, as is usually the case in the genus.

The mastax is of the malleate type, and the anatomy is normal to the genus.

Total length, 168μ; toes, 55μ. Width between anterior spines, 60μ; body, 80μ.

HABITAT.—Submerged *Sphagnum*, Atlantic County, New Jersey.

Trichotria cornuta may be called common, but it is never abundant, occurring here and there in many collections. *Trichotria eukosmeta*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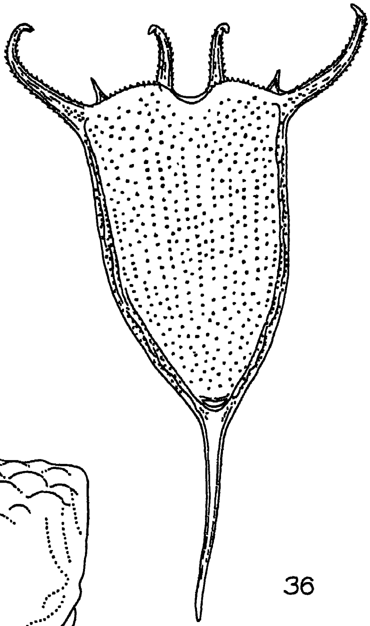
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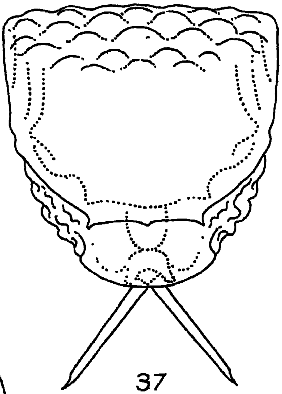
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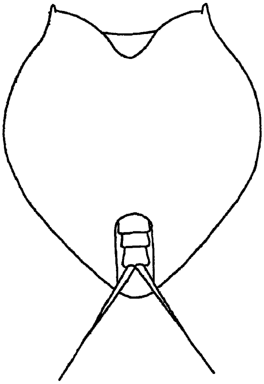
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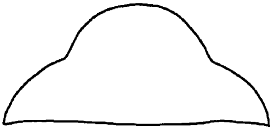
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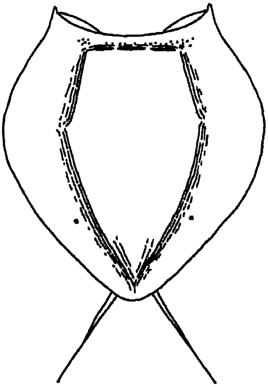
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Fig. 35. *Keratella cochlearis taurocephala*, dorsal view.
Fig. 36. *Keratella cochlearis taurocephala*, ventral view.
Fig. 37. *Lecane pustulosa*, lorica, dorsal view.
Fig. 38. *Lepadella pyriformis*, lorica, ventral view.
Fig. 39. *Lepadella pyriformis*, lorica, cross-section.
Fig. 40. *Lepadella pyriformis*, lorica, dorsal view.

Myers also has a soft lorica, but that species is psammobiotic and has a pair of condyles on the basal foot joint, besides the toes are relatively much shorter.

Type in The American Museum of Natural History. Cat. No. 512.

Lecane pustulosa, new species[1]

Figure 37

The outline is broadly reverse-ovate. The integument is quite flexible, but the form is constant. The anterior margins are coincident and nearly straight; no spines are present at the antero-lateral angles. The surface markings of the dorsal plate are peculiar; they consist of a series of bosses arising near the anterior margin and diminishing posteriorly for about one-third the length of the plate, leaving the remainder free from markings. The ventral plate is as wide as the dorsal, and the lateral sulci are evanescent. The coxal plates are oval and poorly defined. The first foot joint is indistinct; the second is roughly triangular and does not project beyond the lorica. The posterior lobe is round and strongly projecting. The toes are rather long, slender, and straight, terminating in short, acutely pointed pseudo-claws.

Length of lorica, 52μ; dorsal plate, 38μ; toes, 23μ. Width of anterior margin, 45μ.

HABITAT.—*Hygropsammon*, Lenape Lake, Atlantic County, New Jersey.

Lecane pustulosa is easily recognized when seen, as there is no other member of the genus with similar markings on the dorsal plate.

Type in The American Museum of Natural History. Cat. No. 980.

Lepadella pyriformis, new species

Figures 38, 39, 40

The body is pyriform in outline, the greatest width being just above the middle, from whence it narrows gradually to a rounded posterior angle. Near the anterior margin of the dorsum, an elevation arises very suddenly which increases in width for a short distance then gradually diminishes, ending in a low flange. The dorsal sinus is shallow and concave and is surrounded by a faintly stippled collar. The ventral sinus is roughly V-shaped, the lateral margins of which are convex, with the apex of the V rounded. The foot groove is parallel-sided throughout. The foot is rather short, and the terminal joint somewhat longer than either the basal or the second joints. The toes are very long; they diminish gradually for about one-half of their length and are continued as extremely slender, drawn-out tips.

Length of lorica, 96μ; foot groove, 18μ; terminal foot joint, 8μ; toes, 40μ. Width lorica at widest point, 78μ; anterior points, 38μ. Depth lorica, 48μ; anterior sinus, 8μ; ventral sinus, 14μ.

HABITAT.—Among submerged *Sphagnum*, Tamaque Lake, Pocono Plateau, Monroe County, Pa.

Lepadella pyriformis is closely related to *L. xenica* Myers. It differs from that species in the shape of the lorica, the depth of the lorica, shape and depth of the dorsal and ventral sinus, shape of the foot groove, and the shape of the toes. The median elevation of the dorsal plate arises very suddenly anteriorly and is preceded by a short collar, whilst that of *Lepadella xenica* arises gradually from the anterior margin.

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[1] In order to save duplication of figures, details lying below the dorsal plate are shown by dotted lines.

Type in The American Museum of Natural History. Cat. No. 992.

Euchlanis dilatata var. **crassa,** new variety

Figures 29, 32

This variety differs from *Euchlanis dilatata* Ehrenberg, in the great depth of the lorica and the very short toes. All of the remaining characters, including those of the trophi, agree with that species.

HABITAT.—Plankton collections from Penask and Nicola Lakes, Kamloops region, British Columbia. "Mariensee" near Danzig, Germany.

Measurements of average specimen from British Columbia: length lorica, 250μ; toes, 50μ; depth lorica, 135μ. Specimens from near Danzig: length lorica, 294μ; toes, 65μ; depth lorica, 197μ.

Type in The American Museum of Natural History. Cat. No. 967.

Keratella cochlearis var. **taurocephala,** new variety

Figures 35, 36

This variety is characterized by the widely divergent antero-lateral spines. The pattern of the dorsum follows that of *Keratella cochlearis* (Gosse), by being disposed into facets mesially divided, the enclosed areas being delicately marked by minute reticulations. The mental edge of the ventral plate is membranous and finely denticulate. The venter is covered by minute pustules following no definite pattern.

Length of antero-lateral spines, 46μ; length of lorica, from base of antlers to the anal vent, 108μ; length of posterior spine, 82μ. Width between tips of antero-lateral spines, 120μ; lorica, 75μ.

HABITAT.—Maine, New Hampshire, New Jersey, Pennsylvania, Florida, Wisconsin, Michigan.

Keratella cochlearis taurocephala has been known since 1915. At that time specimens were sent to Mr. Charles Rousselet, who suggested creating a new species for it. It has been held in abeyance ever since. In response to several requests from limnologists the variety is hereby named.

Type in The American Museum of Natural History. Cat. No. 993.

Keratella cochlearis var. **punctata,** new variety

This variety is slightly smaller than the preceding, and differs from it in that the areas enclosed by the facets are uniformly covered by minute pustules instead of reticulations.

Length of antero-lateral spines, 42μ; length of lorica, from base of antlers to anal vent, 98μ; length of posterior spine, 74μ. Width between tips of antero-lateral spines, 110μ; lorica, 64μ.

HABITAT.—Same as preceding.

Type in The American Museum of Natural History. Cat. No. 994.

Family **Testudinellidae**

Filinia camasecla, new species

Figure 34

The shape of the lorica is roughly quadrilateral, truncate anteriorly, and angular posteriorly. The integument is somewhat stiffened so that the shape of the body is very constant. There are three spines of medium length, all slightly enlarged at the base; two laterals, situated near the middle of the body length, and one terminal. The lateral spines are not actuated by special muscles. During locomotion they lie close to the body; when the head is retracted they are forced out at right angles by hydrostatic pressure. The remainder of the anatomy is normal to the genus.

Length of lorica, 84μ; posterior spine, 90μ; lateral spines, 86μ. Width of lorica, 78μ.

HABITAT.—Gatun and Mireflores lakes, Panama, June and July, 1924.

Filinia camascela somewhat resembles *Filinia brachiata* (Rousselet), but differs in the following particulars: The body is smaller (Rousselet gives the body length of *F. brachiata* as 95μ). The general shape of the body is different, that of *F. brachiata* being elongate oval; the length of the spines is relatively much longer and they are not nearly as stout at the base. The posterior spine of *F. camascela* is terminal, while that of *F. brachiata* is not quite terminal, but stands out on the ventral side a little above the posterior limit of the lorica.

Type in The American Museum of Natural History. Cat. No. 954.

NOTES ON SPECIES

PSEUDOPLOESOMA, NEW GENUS

Ploesoma formosum MYERS, 1934, American Museum Novitates, No. 700, pp. 4, 5, 6, 7, Figs. 2, 3, 4.

Ploesoma formosum differs in so many particulars from the characters of the genus *Ploesoma* that a new generic name is hereby proposed. The differences are:

1.—No frontal palps of the corona, as in other species of the genus.

2.—The dorsal antenna emerges from a frontal sub-square notch, and not from an oriface situated on the dorsum.

3.—The venter is confluent, not cleft.

4.—The foot emerges from an oval opening, and not from the ventral cleft.

5.—The foot is composed of telescopic segments, not transversally wrinkled.

6.—The mastax is of the virgate type, and not secondarily adapted for prehension.

7.—The presence of the juxta-buccal protuberances, evaginated in the central portion, are unique among the known rotifera.

8.—The dorsum is cleft longitudinally.

9.—The adults are pigmented an orange-red.

10.—Found only in supra-acid associations of pH 4.0–6.8.

Notommata diasema Myers

Figure 20

1937, American Museum Novitates, No. 830, pp. 11, 12, Figs. 5, 9, 16.

During the summer of 1937 this species was found in such numbers that an examination of living material, stained with brilliant cresyl blue, revealed a secondary pair of sub-cerebral glands over twice as long as the primary pair, and extending some distance below the retrocerebral sac. This condition is unique in the genus *Notommata.*

Dicranophorus thysanus Harring and Myers

MALE.—The male of this species is somewhat smaller, but otherwise the general shape is an exact replica of the female. Of the alimentary tract only the connecting band between the testis and the corona remains. There is no bladder. The testis is rather small and globular and the ductus seminalis is without terminal cilia. Situated just in front of the testis is a black, globular mass crowded with opaque granules.

Total length, 325μ; toes, 45μ.

Type in The American Museum of Natural History. Cat. No. 886.

FEEDING HABITS OF *DICRANOPHORUS THYSANUS* AND *DICRANOPHORUS ISOTHES*

Dicranophorus thysanus HARRING AND MYERS, 1929, Trans. Wis. Acad. Arts, Science, XXX, pp. 710, 711, Pl. XXVII, Figs. 1, 2, 3.

Dicranophorus isothes HARRING AND MYERS, 1929, Trans. Wis. Acad. Arts, Science, XXX, pp. 708, 709, 710, Pl. XXVII, Figs. 6, 7, 8, 9.

Among the members of the genus *Dicranophorus* the above two rotifers stand out, not only on account of their large size, but also on account of their interesting habits.

Both are acid-water animals and are generally found among submerged *Sphagnum.*

Dicranophorus isothes feeds only on small *Cladocera,* such as *Alona* and *Chydorus.* Its method of procuring food is very interesting. It pounces upon its prey with great rapidity and feels it all over. It seems that the frontal tactile processes are an adaptation serving this purpose. As this species only feeds on *Entomostraca* having a bivalve carapace, it thrusts its head between the valves, either on the ventral side or the posterior portion. In response to this irritation the cladoceran contracts the valves vigorously, frequently squeezing the rotifer's neck quite flat. *Dicranophorus isothes* does not seem to mind this, however, but patiently waits until the cladoceran begins to tire and relaxes the valves a little. The rotifer now thrusts its head in a little farther. This keeps up until the intestine is reached, when the powerful jaws are thrust out and the rotifer begins to feed, not desisting until the carapace of the cladoceran is completely emptied.

As opposed to the above method of feeding, the habits of *Dicranophorus thysanus* are contrasted. While its jaws are also of the forcipate type and partly prehensile, it has never been observed to use them on living animals, as it feeds only on carrion. It immediately attacks dead *Entomostraca* and aquatic worms, devouring everything except the carapace, or cuticle. If a number of the rotifers are placed in a container and a crushed *Daphnia* or pieces of worms, such as *Nais*, are introduced, the rotifers will at once swarm around the remains and consume them.

Owing to this habit, it is easy to culture these species. All that is necessary is to keep the water containing them fairly pure, provide them with the proper food, and maintain the proper p_H value.

CORRECTION

Pseudonotholca japonica MARKAWA, 1928, Annot. Oceanograph Res. Tokyo, 2 (I): (3), 2 figs.

Notholca quadrispinata MYERS, 1936, Trans. Amer. Micro. Soc., LV, No. 4, p. 432, Fig. 9.

The latter species is plainly a synonym for Markawa's animal.

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COOPERIA TOTADENTATA, A REMARKABLE RHINOCEROS FROM THE EOCENE OF MONGOLIA[1]

BY HORACE ELMER WOOD, 2ND

A large number of interesting undescribed rhinocerotoids, collected by the Central Asiatic Expeditions, were assigned to me for study and description by the late Professor Henry Fairfield Osborn and Dr. Walter Granger of the Department of Vertebrate Palaeontology of The American Museum of Natural History. The important but rather isolated and perplexing specimen which forms the subject of this paper was identified as a titanothere in the field and as an amynodont, following preparation. Study showed, however, that it is an altogether new type of rhinoceros without close resemblance to any previously known form.

I am indebted to Dr. Granger for information dealing with the stratigraphy of this and other finds and to Mr. Jack N. Peterman for the accompanying original drawings.

RHINOCEROTIDAE

COOPERIA, NEW GENUS[2]

TYPE SPECIES.—*Cooperia totadentata*, described below.

DIAGNOSIS.—Size of large species of *Trigonias*, e.g., *T. gregoryi;* nasals smooth, slightly convex dorsally from front to rear and, more markedly, from side to side, with anterior tips not retracted but forming a stubby triangle; posterior end of nasal incision above canine; premaxillaries somewhat deflected, anteriorly; I^3, C^1, P^4, M; $C^1 > I^2 > I^3$; I^3 caniniform; canine stubby, large, not hypertrophied; none of premolars molariform—P^2 most progressive, followed by P^3, then P^4; P^1 extremely primitive, composed principally of parametacone (or amphicone), with small basal protoloph and still lower antero-internal cingulum; P^{2-4} have paracone and metacone, and P^{3-4} have parastyle, as well, forming strong external ribs on the ectoloph, with the paracone rib most prominent throughout; protolophs and metalophs of P^{2-4} converge into V's, which are modified by partial separation of hypocone in P^2, and by incomplete fusion of metaconule and protocone in P^4; P_4 inferred to have been considerably shorter than either P_2 or P_3.

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[1] Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 137. Assisted by a grant from the Penrose Fund of the American Philosophical Society in Philadelphia.

No. 136 of this series is Novitates No. 989, the serial number of which was inadvertently omitted. Ed.

[2] This name recognizes the valuable work of Mr. C. Forster Cooper on the fossil rhinoceroses. It is also designed to suggest relationship to the baluchitheres in a manner without unfortunate connotations if this inference be hereafter disproved.

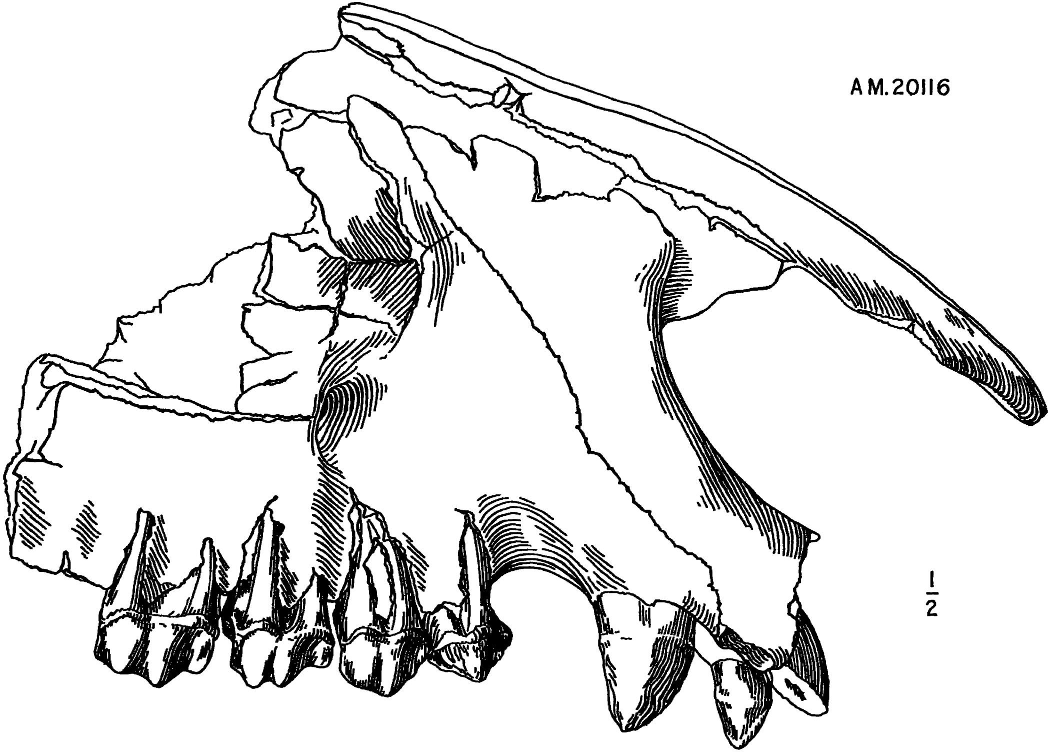

Fig. 1. *Cooperia totadentata*, right side, A.M.N.H. No. 20116, × $^1/_2$.

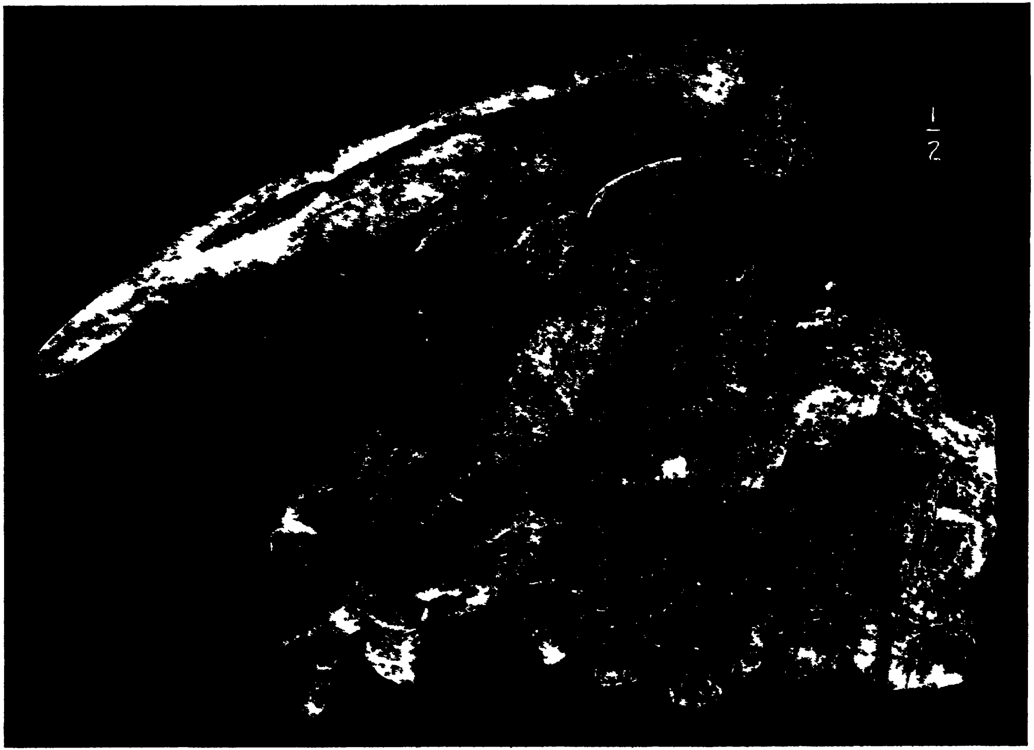

Fig 2. *Cooperia totadentata*, left side, A.M.N.H No. 20116, × $^1/_2$.

Cooperia totadentata, new species[1]

TYPE.—A.M.N.H. No. 20116, front of skull with all premolars and some front teeth, collected by George Olsen, June 5, 1923, Field No. 173.

HORIZON.—Irdin Manha Formation, Upper Eocene.

LOCALITY.—Telegraph Line Camp, 2 miles north of line, Irdin Manha Bench, 23 miles southeast of Iren Dabasu, Inner Mongolia.

DIAGNOSIS.—Only known species of genus; measurements given below.

OSTEOLOGY

The severe lateral crushing to which the skull had been subjected obscures some characters. The tips of the nasals form a blunt isosceles triangle, as in *Hyrachyus* and *Amynodon*, but are not retracted, ending about above the first incisor as in hyrachyids and many true rhinoceroses, but unlike hyracodonts and amynodonts. The nasals apparently lack lateral notches and lack any indication of horn rugosities. The curved dorsal profile is not exactly like any other rhinoceros, and the angulation between the dorsal profile and the dental plane of occlusion is unreliable, as the premaxillaries and maxillaries have been telescoped over the nasals, probably more so anteriorly than posteriorly, thus increasing the angle between tangents to the two surfaces by an undetermined amount. The curve of the profile does not seem distorted and is vaguely amynodont, but the length of the arc suggests the baluchitheres only (Figs. 1–2). Its sweep in *Cooperia* is readily derivable from the primitive hyrachyid condition, and could readily give rise to the baluchithere condition as restored by Granger and Gregory (1936) in less exaggerated and, I believe, more accurate form than in previous restorations. The posterior end of the nasal incision is above the canine. This incision is more prominent than in *Hyrachyus*, shows some resemblance to *Amynodon* and is less prominent than in the baluchitheres. It is very different from *Trigonias*, *Subhyracodon* or similar primitive but already unmistakable true rhinoceroses in which the characteristic shape of the facial region is due to the sharp, oblique angle between the descending rim of the premaxillary and the nearly horizontal dorsal edge of the anterior end of the same bone in front of the premolars, to which the ventral border is parallel. This condition is characteristically rhinocerotid and is not found in the other families, although it is also modified in some later specialized rhinocerotids. The tips of the premaxillaries are missing so that their original relation to each other is uncertain, but they were probably fairly long and in contact. Enough is preserved, particularly on the left side, to suggest a down-turned anterior end of baluchithere type, but much less pronounced in degree. This is shown not only by the angulation of the ventral border of the premaxillary with the occlusal plane of the premolars but also by the fact that the gum-line on the root of left I^2 is deflected about four millimeters ventrally below the gum-line of I^3 with reference to the premolar occlusal plane (Figs. 1–2). This deflection of the premaxillaries does not seem to be due to crushing but it is impossible to be positive about so badly distorted a specimen. The premaxillary-maxillary sutures pass a short distance in front of the canines. The lateral crushing of the skull tends to obscure the original skull proportions, giving a probably fictitious (or, conceivably, merely exaggerated) appearance of the presence of preorbital pits comparable to those of *Amynodon advenus,* and telescoping the dorsal rims of the premaxillaries and maxillaries over the ventral borders of the nasals (Figs. 1–2). The infraorbital canal widens, posteriorly, and opens, anteriorly, above the front of P^3, on the side of the face, as in true rhinoceroses, not in the presumably artificial "preorbital fossa" as it should if it were an amynodont. The diastema is short as in primitive forms which have not lost nor atrophied any of the teeth, e.g., *Hyrachyus,* but this character is not especially diagnostic: for example, this condition is not very different from that in *Hyracodon.* The incisive foramen appears to have been long and narrow, but this, also, cannot be regarded as certain; and the palate is so badly crushed together that no data can be obtained, except the unexciting fact that a hard palate was present.

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[1] The specific name indicates the presence of the primitive placental tooth formula without reduction so far as the evidence goes.

DENTITION

The calcareous deposit on the teeth must not be confused with cement, as it includes sand grains similar to those in the remains of the quartzose sandstone matrix which still adheres to the specimen. The teeth are unworn or barely worn. The tips of the premaxillaries are broken off, leaving only the base of the alveolus of I^1, right. I^1 could hardly have been a small tooth, as the root was evidently comparable to that of I^2 in length; it is not clear whether the tooth was larger or smaller than I^2 (Fig. 3). It could hardly, however, have been an enlarged tooth of rhinocerotid type—at least, if so, the root was of the type found on a sharply-pointed incisor. The base of the root of I^2, right, and the entire root of I^2, left, are preserved. The circumference is considerably greater than for I^3 at comparable levels, considerably smaller than for the canine. The apex of the root is strongly curved to the rear, recalling the condition in the incisors of *Amynodon advenus.* However, no special significance attaches to this fact, as the condition is even more similar in the enlarged I^3 of the living tapirs (e.g., *Tapirus indicus*, A.M.N.H. No. 80077, and *T. terrestris*, A.M.N.H. No. 36661). This appears to be a mechanical necessity whenever the root is longer than the vertical depth of the premaxilla. I^3, right, had dropped out of the alveolus after death and before fossilization; I^3, left, is unworn, small, simple, stubby, essentially caniniform, with anterior and posterior flanges and with a few vertical ribs barely indicated on the antero-external face. The left canine, like I^3, right, had dropped out after death; the right canine is short, stubby, pointed, with flanges front and rear and a short median flange at the tip, with the antero-external surface between the flanges showing a vertical, rugose ribbing even coarser than that on P^1. On any basis of comparison, the canine is markedly larger than either I^3 or I^2; the relation to I^1 is not so clearly demonstrable, but the canine was probably larger (Figs. 1, 3 and 4).

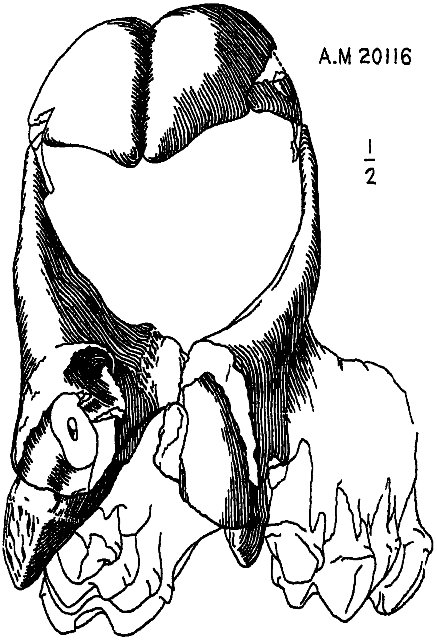

Fig. 3. *Cooperia totadentata*, anterior end of skull, A.M.N.H. No. 20116, × 1/2.

As the first right and left premolars of this specimen are less worn than the other premolars, they are treated as members of the permanent series. None of the premolars are yet molariform (Figs. 4 and 5B). P^2 is the most progressive, followed by P^3, then P^4 and then, at a long interval, by the extremely primitive P^1. The premolars show no special amynodont features; on the contrary, they are similar to primitive true rhinoceros premolars in general, and suggest those of *Trigonias* and the baluchitheres in almost every character (Fig. 5). P^1 has a single main cusp, the parametacone or amphicone, with flanges front and rear. The external slope of the ectoloph carries coarse, vertical ribs. The external cingulum is narrow but continuous. The protoloph, apparently of cingular origin, forms a rib down the internal slope of the parametacone, swings around the internal edge of the cusp and becomes nearly (P^1, left) or entirely (P^1, right) confluent with the posterior cingulum. A lower antero-internal cingulum goes from the clearly defined parastyle (usually less defined) about to the junction of the protoloph and postero-internal cingulum. Minor ribs on the internal slope of the parametacone represent the sites of the potential crista and metaconule, respectively, the "metaconule" being the more prominent of the two. There is also an internal rib on the main cusp, just behind its junction with the parastyle. P^{2-4} show double, strong ribs, the paracones and

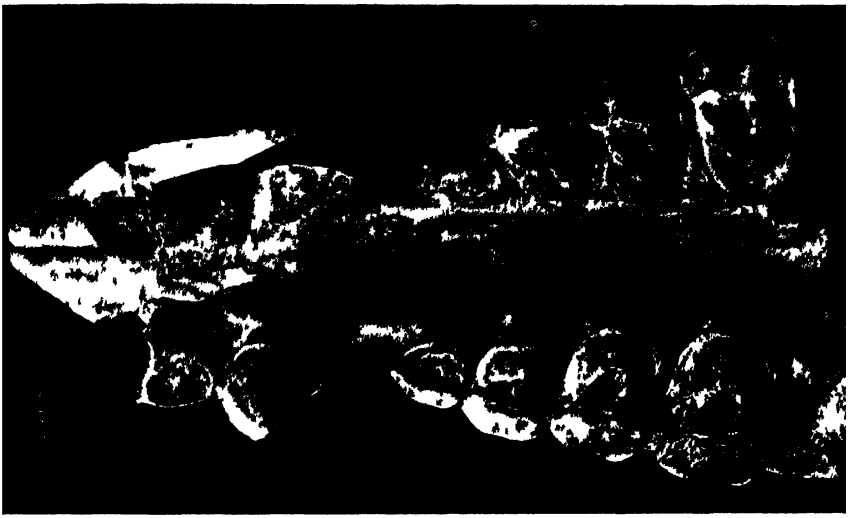

Fig. 4. *Cooperia totadentata*, palate, A.M.N.H. No. 20116, × $^1/_2$.

metacones, on the external slopes of the ectolophs, the anterior (paracone) ribs being the more prominent. The external cingula are prominent at the base of these cusps but interrupted between them. The premolar parastyles, of nearly normal rhinocerotic type (i.e., not hyrachyid), become progressively more prominent from front to rear, being unusually everted and clearly defined by parastylar grooves on P^{3-4}, as compared with true rhinocerotids in general. The attachment of the protoloph to the ectoloph becomes progressively higher on the crown and more intimate from P^1 to P^4. However, it is not really low on P^2, where it is of the primitive, true rhinoceros type and definitely not hyrachyid. The attachment of the metaconule to the metacone is high and very similar on P^{2-4}, giving various modifications of the V-pattern. The hypocone of P^2 is partly budded off from the protocone and is about equally attached to the protoloph and the metaconule. A minute crochet is present. The median valley is an enclosed medifossette, with the anterior "wind-gap" between the protoloph and ectoloph slightly lower than the posterior one over the middle of the metaconule. The crista of P^2, left, is a thin ridge, double proximally; P^2, right, has hardly any crista but a similar condition is barely indicated. The cingulum continues from the anterior side, internally and then posteriorly, but nearly merges into the internal slope of the protocone at its internal end. The internal end of the protoloph (protocone) of P^3 is recurved and curves slightly posterior to the internal end of the metaconule, but shows no trace of a differentiating hypocone. A posterior groove descends buccad as the boundary between the protocone and metaconule. The medifossette seems deeper than on either P^2 or P^4, but is actually a little shallower than on P^4. The transverse crests of P^3 approximate a V with a blunted apex, and the transverse lophs form a more nearly continuous crest than in the other premolars. There is a small crista on P^3, left, barely indicated on P^3, right. The internal cingulum is briefly but definitely interrupted at the protocone. P^{3-4}, right, have small ribs which might be called crochets, except that they occur exactly at the junction of the metaconule and ectoloph. These ridges are absent on the left side. P^4 is generally similar to P^3 but is larger, and the metaconule is less firmly joined to the protocone, as the median valley has a partial outlet to the rear over a high saddle. The metaconule is more curved than in P^3. Both P^4s show the faintest trace of an internal groove, basally, incipiently delimiting the hypocone from the protocone. As usual, the tooth is somewhat rounded off, postero-internally, as compared with P^3. The cingulum should probably be described as tenu-

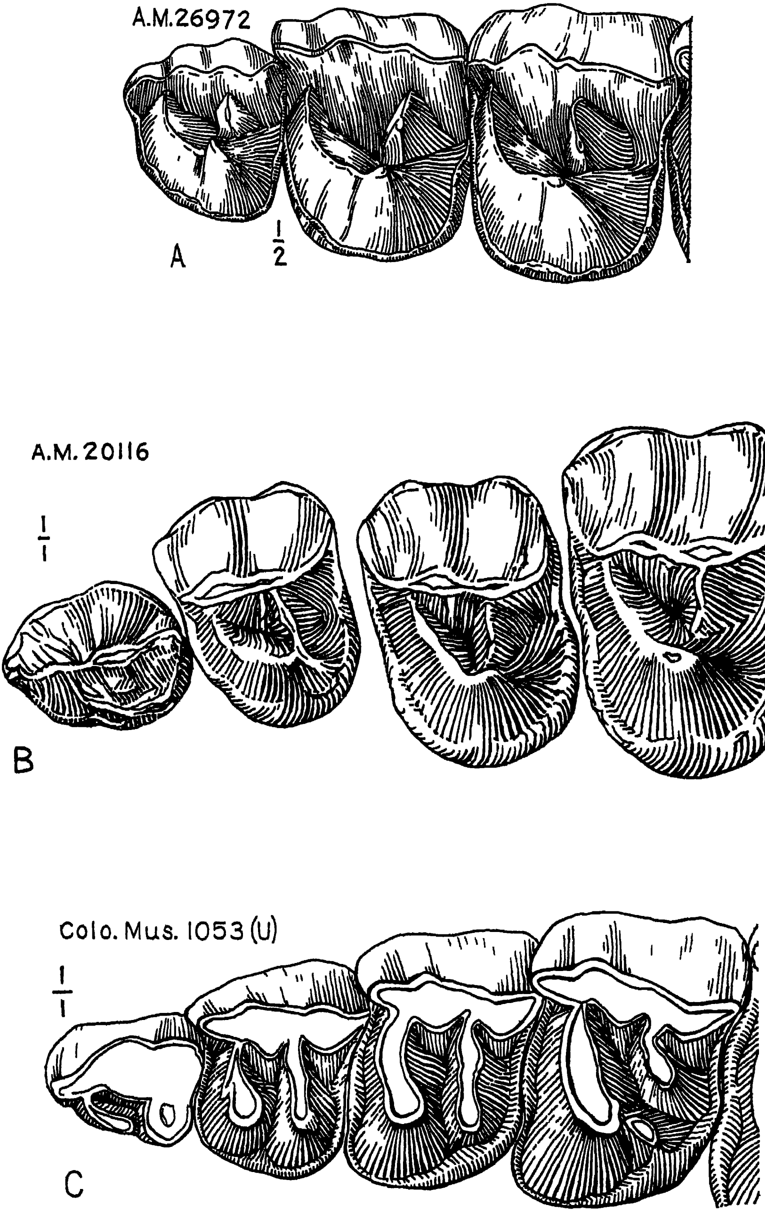

Fig. 5. A, *Indricotherium asiaticum* Borissiak, right P^{2-4}, reversed, from cast, A.M.N.H. No. 26972, after Granger and Gregory, × $^1/_2$. B, *Cooperia totadentata*, P^{1-4}, left, A.M.N.H. No. 20116, × 1. C, *Trigonias cooki* Wood, P^{1-4}, left, Colorado Mus. No. 1053 (U), × 1.

ously continuous internally rather than as barely interrupted by the protocone. All three rear premolars suggest *Trigonias*, but P^4 shows the closest resemblance (Fig. 5B and C).

INFERRED CHARACTERS OF LOWER TEETH

In view of the importance and anomalous character of this specimen it is desirable to formulate such inferences regarding the lower dentition as can safely be drawn from the amount and location of wear on the upper teeth, from the boundary angles between the wear facets for the respective lower premolars, and from the requirements for normal occlusion with the upper teeth.[1] As I^3 and C^1 are unworn, the lower canine can hardly have been hypertrophied on the amynodont pattern and may well have been somewhat smaller than the upper canine. P^1 is noticeably worn only behind the tip of the parametacone indicating that P_1 was probably small or absent. Right P^1 is faintly worn anteriorly and left P^1 quite unworn, which appears to indicate either the absence of P_1, left, or, rather more probably, that a small P_1 was present on both sides. Since the whole ectoloph of P^2 is worn, whereas the whole internal portion of the tooth is unworn except at the external end of the metaconule, it may be inferred, with considerable confidence, that P_2 was a primitive tooth consisting primarily of an antero-posterior blade composed of the protoconid and hypoconid. It must have been about 28.5 mm. long. The ectoloph of P^3 is well worn and the protoloph slightly, on each side, also the right metaconule, that of left P^3 being unworn Evidently P_3 had asymmetrical trigonid and talonid crescents of rhinocerotoid type, the trigonid being much higher. The hypoconid was still the main talonid cusp, with the anterior limb lower than the postero-external corner, and the posterior limb of the talonid crescent dropped rapidly to or toward the cingular level, much as in P_4 of *Hyrachyus*. P_3 was approximately 30 mm. long, allowing for the crack which has now separated left P^2 and P^3 over 2 mm. beyond their position in life. The wear on P^4 is very similar to that on P^3, and P_4 must have been, structurally, very like P_3, except for its surprising antero-posterior shortness, as it was apparently only about 22 mm. long, on each side, which is markedly shorter than either P_2 or P_3. This is a very unusual character, but the inference is almost inescapable, unless one assumes that the dP_4s had been retained, but were reduced to short teeth by interproximal wear (Wood, 1938). The total antero-posterior length of P_{2-4}, over all, must have been close to 83 mm.

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[1] The principles of occlusion as applied to rhinoceroses have been discussed elsewhere (Wood, 1934).

MEASUREMENTS

The measurements, in millimeters, follow, compared with those of a cast (A.M.N.H. No. 26972) of Borissiak's figured specimen (Borissiak, 1924, Pl. I, fig. 6), No. 1441–3 a-g (Beliajeva, 1928, p. 244) which is similar in stage of wear, and with those of *Trigonias gregoryi*, which is also little worn and of similar size. The general resemblance of the premolars of *Cooperia* to those of *Trigonias* has already been emphasized (cf. Fig. 5, A, B and C).

	Cooperia totadentata, type, A.M. No. 20116		*Indricotherium asiaticum* Borissiak, cast, A.M. No. 26972	*Trigonias gregoryi* Wood (1927), type, A.M. No. 13226a	
	Right	Left	Right	Right	Left
I^2 A.P.		est. 15.1			
I^2 Tr.		est. 18.4			
I^2, circumference at neck		51.0			
I^3 A.P.		14.4			
I^3 Tr.		14.7			
I^3, circumference at neck		45.0			
I^3, height of crown		15.4			
C^1 A.P.	24.5				12.5
C^1 Tr.	21.2				7.5
C^1, circumference at neck	70.0				
C^1, height of crown	26.3				7.5
P^{1-4}	108.5	107.0		114.0	115.0
P^{2-4}	85.7	81.4	151.9	88.5	88.5
Diastema	29.8	28.0		37.0	37.0
P^1 A.P.	24.2	24.2		26.0	25.5
P^1 Tr.	20.5	19.0		23.0	24.0
P^2 A.P.	22.9	23.2	40.9	27.5	27.5
P^2 Tr.	29.8	30.0	51.0	35.0	35.0
P^3 A.P.	26.3	26.3	50.9	29.0	29.5
P^3 Tr.	38.5	38.4	71.0	45.0	44.5
P^4 A.P.	31.0	30.2	57.5	32.0	31.0
P^4 Tr.	45.4	45.7	79.1	50.0	50.0
Estimated length nasal incision	101.0				
Probable original depth, dorsum of nasals to Paracone of P^2	195.0				

DISCUSSION

It is obvious from the description and illustrations that the taxonomic and phylogenetic allocation of this form involves difficulty in interpreting its apparently contradictory characters. The broadly diagnostic features are:

1.—The complete placental formula for the upper dentition, as any number of molars other than three is of negligible probability. This set most probably occluded with a complete lower dentition.

2.—A rather stubby, reasonably enlarged but not hypertrophied upper canine, associated with a full set of upper incisors, which are certainly not degenerate, but none of which are demonstrably hypertrophied. This type of front teeth would fit best into any other family of rhinocerotoids than the Rhinocerotidae.

3.—P^{2-4} of primitive true rhinoceros pattern, suggesting, especially, *Trigonias* and the baluchitheres, but which may also be compared with other primitive rhinocerotids.

4.—A very primitive P^1, suggestive of *Ephyrachyus cristalophus*, or of still more primitive perissodactyls.

5.—A snout differing from any other rhinoceros, but with elusive resemblances in various directions.

6.—"Pre-orbital pits," which are probably, but not demonstrably, artifacts due to crushing.

7.—Premaxillaries apparently somewhat deflected.

The following hypotheses might be offered, to interpret this specimen:

1.—It is an amynodont.

2.—It is a hyracodont.

3.—It is a distinct, coördinate line, deserving familial distinction.

4.—It is a stem rhinocerotoid, in which case it should fit (or be forced) into the Hyrachyidae.

5.—It is a true rhinoceros,
  (a) with no close relationship to any other known form.
  (b) morphologically ancestral to *Allacerops*.
  (c) morphologically ancestral to typical later forms, such as *Trigonias*.
  (d) more or less ancestral to the baluchitheres.

Evidences for the amynodont hypothesis are the full set of front teeth (also found elsewhere), the enlarged canine, the curved incisor roots (characteristic of *Amynodon*, but found wherever the roots are too long for the depth of the premaxillary), the dorsal profile of the nasals (but not their length), and the antorbital hollows (which are certainly largely due to crushing and may be entirely so). Opposed to the amynodont hypothesis are the lack of retraction of the nasals and of any other certain amynodont characters, the lack of any real hypertrophy of the upper canine and, almost certainly, of the lower canine as well, the lack of any tendency toward reduction of the incisors, the simple crown of I^3, and almost every character of the premolars, which lack all amynodont features, such as reduction in number and atrophy in size, which are fairly pronounced in even the most primitive species of *Amynodon* (including *"Orthocynodon antiquus"*).[1] No known amynodont (including the undescribed Mongolian forms) has four upper premolars. Four deciduous premolars are present in a number of the more primitive forms, and occasionally a battered dP^1 may be found still in place as the permanent premolars erupt. However, it does not function with them, and, in any case, it bears no resemblance to the P^1 of *Cooperia* which is even less worn than the slightly worn P^2, instead of much more worn as a dP^1 would be. After revising the known amynodonts (ms. essentially complete except on the Mongolian material), I have no hesitation in dismissing the hypothesis that *Cooperia* is an amynodont as of too low an order of probability for further discussion, in spite of its superficial attractions.

Except on a purely verbalistic basis, the hyracodont hypothesis is equally unattractive. No hyracodonts of this size are known, and large ones would be particularly unlikely to occur in Eocene deposits, where known representatives are smallest. The hyracodont canine is never as prominent as this and usually shows more or less reduction. The round, curved root of I^2 would be unlikely to expand into the transversely widened crown of *Hyracodon* or *Ardynia.* The nasals never show this sweep but are characteristically short. The premolars are always of different proportions, being more nearly square rather than rectangular as in *Cooperia* and various true rhinoceroses. Finally, there are no specifically hyracodont features. The one argument for reference to the Hyracodontidae is that it would require least verbal modification of the family definition to include it here, at the cost, however, of a serious actual distortion of the family.

To justify the hypothesis that *Cooperia* belongs to a distinct line coordinate with the other families, would require, at the least, both evidence from a more complete specimen and a line of ancestors or descendants. Moderately isolated forms near a common stem should not be erected into family rank.

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[1] There is evidence in various of Matthew's later writings that, at least at times, he considered the amynodonts as roughly ancestral to the true rhinoceroses. If so, he presumably based this concept either on the restoration of *"Orthocynodon antiquus"* (Scott and Osborn, 1883, Fig. 1) or, possibly, on this restoration in conjunction with the Mongolian specimen described in this paper. Although the inferences made by Scott and Osborn were natural and, perhaps, inevitable in the light of current knowledge (Marsh's skull of *A. advenus* had not yet been prepared) a number were incorrect and the distinctive primitive rhinocerotoid (as opposed to primitive amynodont) characters in their restoration, on which Matthew presumably relied, having been based on misinterpretation, are not actually present in the specimen. In fact, *"O. antiquus"* is specifically inseparable from *A. advenus.* Evidence for this summary statement will be published elsewhere. There is no reason to regard any amynodont as ancestral to any non-amynodont rhinoceros.

Allocation to the Hyrachyidae has even less in its favor. The front teeth do not exclude it from the group, but the premolars, although showing the V pattern, are advanced over the hyrachyid grade, in fusion of the parastyles, fusion of paracone and metacone into an ectoloph, in the development of the metaconules, as well as in less tangible characters. The curves of the nasals and the depth of the nasal incision are also not hyrachyid, although readily derivable from that condition.

Assignment of *Cooperia* to the true rhinoceroses agrees with the skull and premolar characters. It is apparently, however, more or less in contradiction to the characters of the front teeth, even as recently redefined (Wood, 1927, p. 9). However, the definition of the front teeth of the Rhinocerotidae has been progressively emended, during the present century, to cover *Trigonias*, the baluchitheres and *Allacerops*, so that very little further stretching is required to admit *Cooperia*. It is obvious, except to a creationist, that the progress of discovery is bound to require such emendations. It is entirely possible that the Rhinocerotidae are now becoming an unwieldy group which would benefit by further subdivision, but such subdivision would be premature at the present moment.

The next problem is to evaluate the probability of subhypotheses a, b, c and d (see above). The rather negative subhypothesis (a) that *Cooperia* is a sort of Mahomet's coffin with no close relationship with any known form, will, of course, be sustained only if all attempts to connect it with other forms fail. The hypothesis of ancestry to *Allacerops* has much to commend it at first sight, except the large size of *Cooperia*, especially for its age. The negative evidence consists in an undescribed form in the Shara Murun which seems to meet all the requirements for ancestry to *Allacerops*, and which, in turn, seems structurally derivable from an undescribed form in the Irdin Manha which is fairly different from *Cooperia*. There may have been some relationship between these two forms but hardly a close one.

Ancestry to typical true rhinoceroses such as *Trigonias* is a tempting hypothesis, in view of the long search for such forms and the more or less conflicting and disputed claims of *Prohyracodon*, *Eotrigonias* and *Caenolophus*. P^{2-4}, if found isolated, would certainly have been considered a new Mongolian species of the genus *Trigonias* (cf. Fig. 5A and B), and far-reaching (and incorrect) conclusions might have been drawn from this erroneous identification. The difficulties with the hypothesis of ancestry to the true rhinoceroses in general are that the front teeth show no evidence of such relationship, as would be expected in an Upper Eocene form, that the animal seems larger than would be expected and that the snout does not seem to be evolving in the right direction. None of these difficulties, however, exclude descent without any great modification from such a generalized rhinocerotid, which might be ancestral to the rest of the family (except, perhaps, *Allacerops*).

There are a number of resemblances which favor an ancestral relationship to the baluchitheres, without, of course, interfering with the concept of descent from such a stem form as that suggested in the preceding paragraph. The somewhat downwardly-turned anterior tips of the premaxillaries, apparently not caused by crushing, would, if exaggerated, give rise to the most characteristic feature of the baluchithere skull other than its size. The dorsally convex curve of the nasals, if moderately exaggerated, would become that of *Baluchitherium* as restored by Granger and Gregory (1936, Fig. 1). Similar exaggeration would produce the baluchithere type of nasal incision.

The baluchithere enlarged upper incisor can be homologized with I^1 in *Trigonias* with considerable confidence. Thus A.M.N.H. No. 521 (*Subhyracodon trigonodus*, Osborn, 1898, Figs. 25B and 34C), *Epiaceratherium bolcense* (Dal Piaz, 1930, Pl. XIII, figs. 13–15), an undescribed, loose I^1 in the Bâle collections and other material, apparently show that the original component of I^1 is a sharp conical cusp forming the front end of the typical enlarged incisor. At this stage, it would give the baluchithere condition by further enlargement, without other change. After that, in the typical rhinocerotid course of evolution, an antero-posterior heel forms behind the cusp, as a new structure, after which the root expands under the heel, the heel becomes as high as the original cusp and becomes confluent with it, giving the characteristic rhinocerotid structure. This antero-posterior elongation by adding a heel occurs only in the rhinocerotids, as any enlargement in the hyrachyids or hyracodonts takes the form of a transverse, semi-spatulate blade. Borissiak (1924, Pl. I, fig. 8b) shows a curving root for what must be I^1 of *Indricotherium* which would conform roughly to the curving root of I^2 and to the probable curve of I^1 of *Cooperia.* It seems less difficult, in all, to derive the enlarged, conical baluchithere I^1, without I^2 or I^3, followed by a minute canine, from *Cooperia* than from any more specialized form.

The premolars closely approach the baluchithere pattern, which they would attain with a very slight advance. The baluchitheres are already so large when they first appear[1] that one would expect that, even as early as the Irdin Manha, an ancestral baluchithere would be at least as large as *Cooperia*. In fact, the criticism might legitimately be made that *Cooperia* is not quite specialized enough to be an Upper Eocene incipient baluchithere, especially with the foregoing description of an Ulan Gochu form which already apparently possessed the majority of the baluchithere diagnostic characters. (The Houldjin appears to be about Middle Oligocene, perhaps about equivalent to the upper portion of the "Oreodon Beds," or possibly a shade later; the Ulan Gochu is Lower Oligocene; and the Shara Murun and Irdin Manha are both Upper Eocene, in a broad sense, the Shara Murun being Upper Uinta to latest Eocene, and the Irdin Manha certainly representing some phase, neither the earliest nor the latest, of the Upper Eocene.) Granger and Gregory (1936) point out that *Allacerops turgaica* could be a structural ancestor of the baluchitheres. They use *Allacerops*, quite justifiably, as the most primitive rhinocerotid of which most of the skeleton is known, but it is obvious that it is not the actual ancestor. At the present moment, the baluchitheres lack an ancestor and *Cooperia* lacks descendants, unless this inferred relationship is correct.

[1] The earliest previously described remains of baluchitheres are from the Houldjin and its equivalent, the Baron Sog, in Mongolia and from the *Indricotherium* Beds of Turkestan which are supposedly of equivalent age. An enormous right radius, A.M.N.H. No. 26026, field No. 772, was collected by Liu Ta Ling, July 8, 1928, in the middle gray layer of the Ulan Gochu Formation at Urtyn Obo. Its length is 1041 mm. which accords with a length of 1200 mm. for the radius of *Baluchitherium grangeri* No. 26166 which belongs to the next to the largest size grade (Granger and Gregory, 1936, p. 38), and 1120 mm. for the field measurement of the radius of A.M.N.H. No. 26386 (the radius was not collected) which belongs to the smallest size grade. Besides the approximate agreement in size, there is rough agreement in general character. All other conceivable interpretations (proboscidian, amynodont, embolothere, chalicothere) can be eliminated with entire confidence. The field reference to *Embolotherium* breaks down on the lack of titanothere characters, to say nothing of a size twice that of Chadron titanothere radii. Although this radius (A.M.N.H. No. 26026) is generally rhinocerotid, it shows no special resemblance to any rhinoceros (including such primitive forms as *Hyrachyus*, *Allacerops* and *Trigonias*) except *Baluchitherium*. The general resemblances to *B. grangeri* are obvious from the photographs (Figs. 6–7): it is worth emphasizing the common possession of a much more sharply defined oblique line than in other rhinoceroses (Fig. 6) which presumably marks the upper boundary of the origin of the abductor pollicis longus. There are a number of differences from *Baluchitherium;* the most striking is that the radius, although more than five-sixths as long, is so much slenderer, having a circumference of 301.5 mm. around the middle of the shaft, compared with 500.7 mm. for the corresponding measurement of A.M.N.H. No. 26166. The coronoid process is much more prominent in the earlier form, suggesting somewhat greater flexibility at the elbow. The distal end also shows differences: there is a large well-marked groove presumably for the tendon of the extensor carpi radialis, and a smaller groove medial to it, presumably for the abductor pollicis longus, which, as in rhinoceroses and tapirs, should insert on metacarpal II. These grooves are not defined in *B. grangeri*, not, presumably, because the muscles were smaller, but perhaps because of more limited flexure of the wrist in the bulkier animal, an inference which is partially confirmed by the presence of a well-defined groove for the tendon of the extensor carpi radialis in such more or less primitive and diverse genera as *Hyrachyus*, *Allacerops*, *Trigonias* and *Amynodon*. The carpal articulations also differ: the facettes for the carpals are more sharply distinct and more deeply impressed, not only absolutely, but also relatively, in A.M.N.H. No. 26166 than in 26026, which accords with what must have been a much greater body weight. The total impression from the comparison of these two radii is of an animal which, while well on the road to being a baluchithere, was considerably more primitive, and had a more nearly normal, cursorial habitus, in contrast to the graviportally modified cursorial habitus of *Baluchitherium*. It is a curious fact that in general proportions, although not in size or detailed character, this radius compares best with *Moropus*, which presumably has no other significance than that they belong to perissodactyls with forearms elongated to a similar degree. I abstain, deliberately, from erecting a new name for this radius.

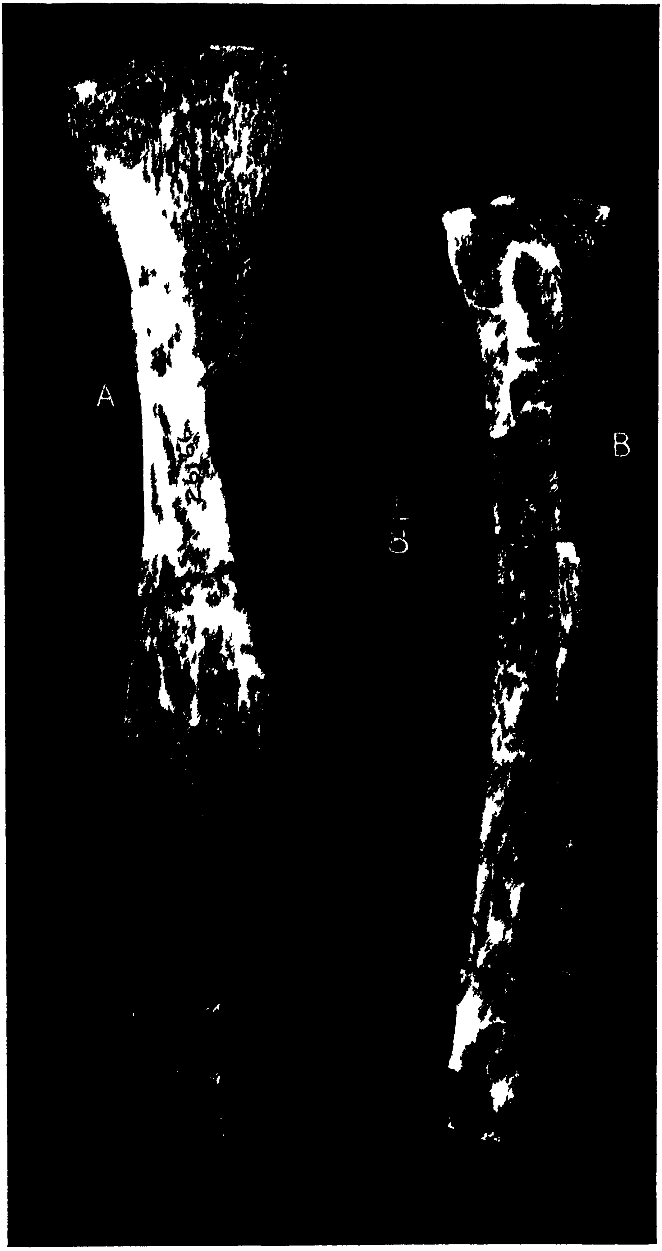

Fig 6 Right radius, anterior aspect, × $^{1}/_{8}$ A, *Baluchitherium grangeri*, A M N H No 26166 B, Baluchithere from Ulan Gochu, A M N H No 26026

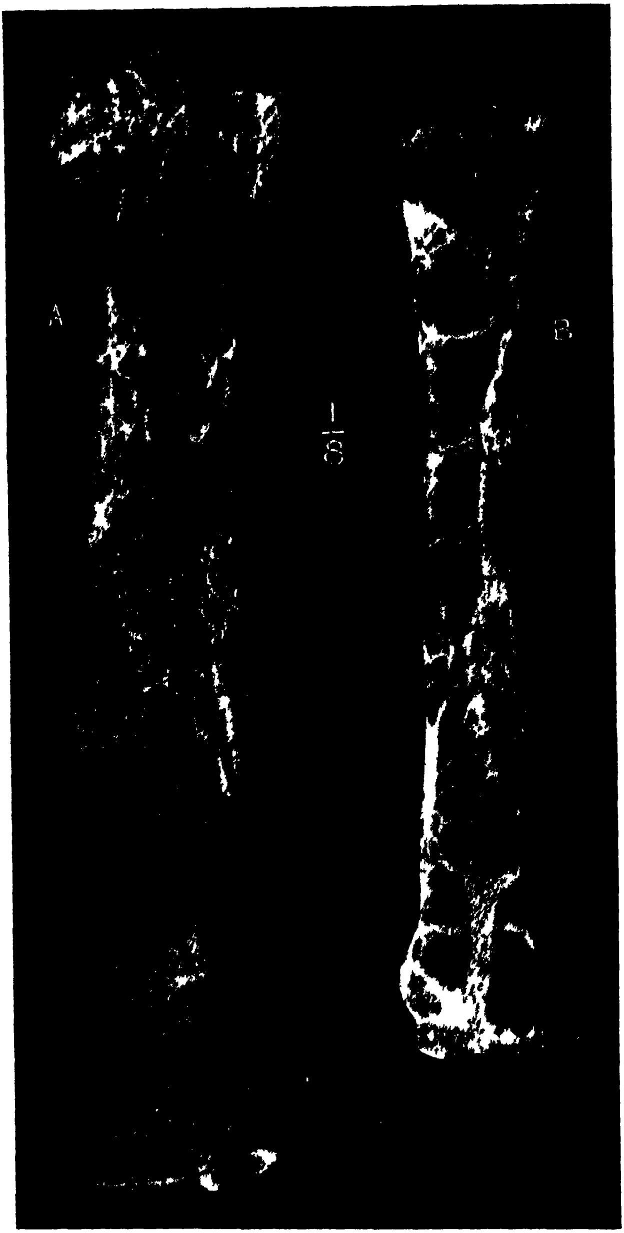

Fig. 7. Right radius, posterior aspect, × $^{1}/_{8}$. A, *Baluchitherium grangeri*, A.M.N.H. No. 26166. B, Baluchithere from Ulan Gochu, A.M.N.H. No 26026.

For *Cooperia* to become a baluchithere, the following changes would be necessary:

1.—Considerable increase in size. (Changes 1–3, however, would be even more marked in case of derivation from any other conceivable Eocene ancestor.)

2.—Exaggeration of characters of nasals and nasal incision which are already present.

3.—Increased deflection of the tips of the premaxillaries. It is obvious that the deflected baluchithere premaxillaries are associated with the similar deflection of the tip of the mandible and the large lower incisor, presumably I_2. This deflection of the mandible and I_2 of *Baluchitherium*, as shown by the Mongolian collections, is much less marked in young than in older specimens. It seems possible, then, that this deflection was only partly genetically controlled, but was aggravated, during the adult life of the individual, beyond the condition that would have been genetically established, by some peculiar stress in the feeding habits. This is, of course, entirely hypothetical, but it is certain that one can match just such bone-deformations of the incisive region of the mandible in human "before-and-after" cases apparently attributable to an abnormal degree of continual forward pushing with the tongue. If this interpretation is correct, the premaxillary region of a young baluchithere would be more like *Cooperia* than older individuals which are alone represented in the collections by the famous American Museum skull (A.M.N.H. No. 18650) although indirectly confirmed by complementary lower jars.

4.—Hypertrophy of I^1, loss of I^{2-3}, great reduction in size of C^1 to conform to the rudimentary alveolus present in A.M.N.H. No. 18650, the type of *B. grangeri*.

5.—Considerable progress by P^1.

6.—Inconsiderable progressive advances of P^{2-4} (principally in smoothing the external surfaces of the ectolophs).

7.—Although the lower premolars are short in the baluchitheres, there is no precedent for the extreme shortness of P_4 in comparison with P_2 and P_3, as inferred for *Cooperia*. This inference, however, is supported by the wear patterns of the ectolophs of P^3 and P^4 on both sides. It might be due to failure to replace the two dP_4s with their consequent extreme attrition in interproximal wear against the adjoining teeth, but there is no definite evidence for such an interpretation.

The interpretation of ancestral relation to the baluchitheres seems more probable than the only likely alternative which would deny special relationship to any known form. The presence of a baluchithere radius, A.M.N.H. No. 26026, in the Ulan Gochu (Lower Oligocene) helps somewhat to bridge the time gap between *Cooperia* and its supposed descendants.

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AMERICAN MUSEUM NOVITATES

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A NEW GENUS AND FIVE NEW SPECIES OF NEOTROPICAL HESPERIIDAE (LEPIDOPTERA-RHOPALOCERA)

By E. L. Bell

All of the type material of the new species of Hesperiidae described in this paper is contained in the type collection of The American Museum of Natural History and specimens of the species for which the new genus is erected are in the general collection of the Museum.

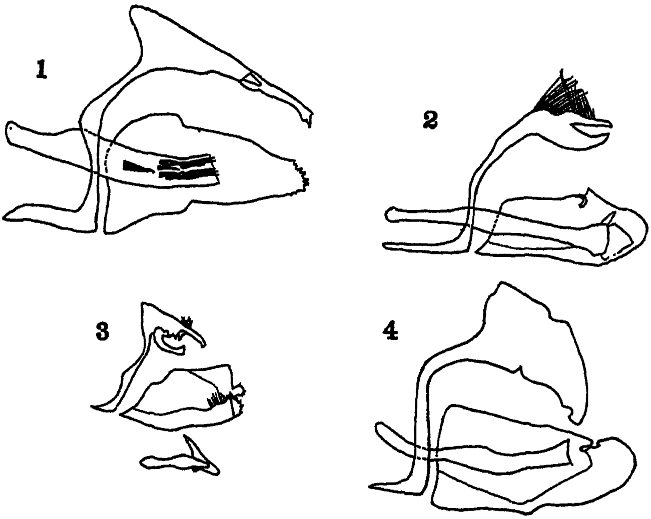
Pyrginae

Phocides colombiana, new species

Figure 1

Male (Upper Side). Primaries black, crossed by an oblique discal band of five spots, composed of a linear dash on the costal margin at about the middle, a subquadrate spot below it across the cell, a larger, similarly shaped spot across interspace 3, one across interspace 2, tapering a little downward, a small triangular spot below vein 2 in interspace 1; two extradiscal subquadrate spots, one each in interspaces 4 and 5; five subapical spots, placed thus: one in interspace 6 a little wider on the upper edge than on the lower, one in interspace 7 triangular, a very small linear streak in interspace 8 above the spot in interspace 7, a minute spot in each of interspaces 9 and 10, the last three spots forming a line extending backward; all of these spots are hyaline. The basal rays are pale metallic blue and heavily developed, in interspace 1 the upper of the two rays is covered with fulvous hairs for about three-quarters of the length, the inner marginal ray below vein 1 is similarly covered except the small, detached spot under the discal band of hyaline spots, which is blue, and there are scattered fulvous hairs on most of the other rays but they are not conspicuous; these rays extend about three-quarters of the distance from the base of the wing to the inner margin of the discal hyaline band, thus there is a band of the ground color between the termination of the rays and the discal band, except the ray in interspace 1 which is narrowly produced along vein 1 and reaches under the triangular spot of the discal band and the ray along the inner margin which terminates as a detached spot under the discal band. There is a submarginal band of blue spots, the three lower spots extending from vein 1 to vein 4 under the lower extradiscal spot, the rest of the band—four to five spots—curving outward around the two lower subapical spots. There is an ill-defined blue dash above the upper extradiscal spot and a very small blue dash on the costal margin outside of the hyaline dash of the discal band. The fringes are black.

Secondaries rather narrow and elongate, with a short but evident hook at the anal angle. Black, the costal area a little paler, extreme base of the wing very narrowly grayish or fulvous; proceeding from the base of the cell is a broad, tapering, bright yellow-fulvous ray extending to or almost to the submarginal band of blue spots, along vein 3; below this and parallel to it is another similarly colored ray, beginning very narrow near the base and widening downward, a few blue scales sometimes show through the fulvous in the basal part of this ray and also in the lower part of it; another very thin, slightly paler ray lies along the edge of the abdominal fold and this ray also sometimes shows blue scales showing through the fulvous; between the broad discal ray, first mentioned, and the submarginal band of blue spots is a short blue ray partly covered with fulvous hairs, this ray is well developed and extends from vein 7 to vein 4, in two specimens there is an ill-defined spot continuing this ray above vein 7. The submarginal band of blue spots begins below vein 8 and extends practically unbroken to below vein 1, curving slightly inward from vein 3 downward, most of the spots of this band have a few fulvous hairs intermixed, especially in the center of the band. Fringes alternately black and white.



MALE GENITALIA

Fig. 1. *Phocides colombiana*, new species. Paratype. Colombia.
Fig. 2. *Thespieus ovallei*, new species. Holotype. Colombia.
Fig. 3. *Pholisora* (?) *maculata*, new species. Paratype. Brasil.
Fig. 4. *Megathymus mejicanus*, new species. Paratype. Mexico.

BENEATH.—Primaries black but paler than above, the hyaline spots repeated. Two blue spots on the costal margin near the base of the wing and a larger blue spot across the cell near the base and extending across the base of interspace 3; a blue dash between the costal marginal hyaline spot of the discal band and the hyaline spot below it; another ill-defined blue stripe beyond it over the end of the cell and extending a little into the cell, the part in the extreme cell end becoming sordid whitish. The submarginal blue band is composed of two large blue spots, one across interspaces 1 and 2 and the other across interspace 3, and above these scattered blue scales representing the remaining blue spots of the band of the upper side of the wing. The basal area of the wing, below vein 3 and along the inner margin, is much paler than the rest of the wing.

Secondaries black with three very bright blue bands, and a very narrow blue stripe along the outer margin of the abdominal fold. Where the wing joins the body it is very narrowly bluish or whitish. The first blue band begins on the costal margin close to the base of the wing and extends to just below vein 1 at about the center of that vein; the next band extends from the basal third of the costal margin to the base of vein 3 and lies about parallel to the first blue band; the third blue band is submarginal and composed of spots, it extends from vein 8 to just below vein 1 and is approximately straight, the spot between veins 3 and 4 being very slightly narrower than those on either side of it and the outer edge of this spot is but very slightly outside of the line formed by the outer edge of the other spots of the band. The abdominal fold is paler than the rest of the wing.

The thorax above is black with a long tuft of fulvous hairs, with a longitudinal black stripe through the center of them extending from the middle of the thorax over the base of the abdomen. The tegulae are similarly colored and joining with the tuft of hairs create the appearance that the thorax is black with four long fulvous stripes. The thorax beneath is black with some pale fulvous hairs along the base of the primaries. The abdomen above is black in the center and on the sides spotted with fulvous and sometimes intermixed with pale blue scales toward the anal extremity; the under side of the abdomen is black, variably spotted with blue on the sides. The anal tuft is black in the center and fulvous on the sides. The shoulder covers are black with four fulvous spots and some bluish hairs on the margin. The collar is black with a bluish, or bluish and fulvous, spot in the center and a whitish spot on each side. The head is black with several bluish and whitish spots. The palpi are black above with a white dot; beneath white. The pectus is white in the center and black on the sides. The legs are black striped with white or bluish. The antennae are black on both sides.

EXPANSE. 56 (type) to 61 mm.

TYPE MATERIAL. Holotype male and two male paratypes from Colombia, exact locality not known.

The form of the male genitalia is somewhat similar to that of *oreades* Hewitson to which species *colombiana* is most closely allied but from which materially differs in superficial characters. On the upper side the hyaline spots of the primaries of *colombiana* are colorless, in *oreades* they are orange-fulvous; the basal rays of *colombiana* are more heavily developed than in *oreades*, the ray below vein 1 is unbroken in *colombiana* and in *oreades* it is composed of two parts, the first being a short, oblique basal stripe. On the secondaries the submarginal band of *colombiana* is practically in a straight line, in *oreades* this band is noticeably out of alinement in the center; the short ray between the discal ray and the submarginal band of *colombiana* is much more developed than in *oreades;* the color of all of the rays is a much paler shade in *colombiana* than in *oreades*. On the under side of the secondaries the spot of the submarginal band between veins 3 and 4 of *colombiana* is only very slightly out of alinement with the rest of the band, while in *oreades* this spot is noticeably out of alinement with the others and the spot below vein 8 is placed inwardly of the two following spots. In the single specimen of *oreades* at hand the spot on each side at the base of the palpi beneath is fulvous and in all of the specimens of *colombiana* these spots are white.

Phocides nigrescens, new species

MALE (UPPER SIDE).- Primaries black, with an oblique discal band of four hyaline spots, the first, small, on the costal margin; the second separated from the first, across the cell; the third across interspace 2; the fourth, triangular, nearly reaching across interspace 1; two very narrow extradiscal hyaline spots extending in an oblique line, one each in interspaces 3 and 4; four subapical hyaline spots, the lower one triangular, in interspace 5; the one above it in interspace 6, subquadrate; the next one in interspace 7 very small; the next one in interspace 8, similar to that in interspace 7 and placed a little basally. A submarginal band of blue spots broken a little inwardly at vein 3, and produced inwardly under the lower subapical spot and in scattered blue scales extending around the subapical spots to that in interspace 8. Above vein 1 the usual basal blue rays are indicated only by scattered blue scales at the base of the wings and a white dot in the base of interspace 1; below vein 1 there is a short, oblique white line at the base and a rather large blue spot extending from under the discal band of hyaline spots to under the submarginal band of blue spots and toward the base in a very thin line of blue scales along the under side of vein 1. The triangular hyaline spot of the discal band, in interspace 1 is surrounded by blue scales at its apex. Fringes dark brownish, slightly excavate between veins 1 and 3.

Secondaries black, the inner margin brownish and paler at the base; abdominal fold brownish with a line of white hairs along the inner edge; a short, narrow bluish-white ray along vein 1, narrowly joining with the lowest spot of the submarginal band; a narrow discal ray from the base of the cell extending along vein 2 and almost connected with the submarginal band; a very short, narrow extradiscal ray obliquely from the base of interspace 6 to vein 3 where it is well separated from the submarginal band; a submarginal band of blue spots in a slightly curved but otherwise continuous line from above vein 7 to below vein 1, the size of the spots tapering gradually downward. Fringes brownish black at anal angle, with a small white spot just before vein 1, white between veins 1 and 2 crossed by black in the center and a small white spot above vein 2, the rest brownish.

BENEATH.—Primaries black, brownish along inner margin to vein 2. Hyaline spots as above. Spots of the submarginal band larger. A small blue spot at the base; a short, ill-defined blue band halfway between the base and the hyaline discal band extending from the costal margin to the base of interspace 2; a blue stripe between the costal spot of the discal band and the cell spot; a few blue scales along and just above the two extradiscal hyaline spots.

Secondaries black, becoming brownish in the abdominal fold. A narrow blue stripe along the outer edge of the abdominal fold and extending in a narrow line at the base of the fringes to vein 1. A narrow blue basal band extending from near the base at the costal margin to the middle of vein 1 and along which it is slightly extended; an oblique, very narrow discal band parallel to the basal band from the costal margin to the base of interspace 3; a submarginal band broader than on the upper side and having the spot below vein 3 slightly out of line inwardly, extending from interspace 7, which it crosses, to vein 1.

Thorax above blackish brown with a white longitudinal stripe on each side and just above the base of the secondaries with long white hairs; beneath brownish with white hairs. Tegulae white along the lower edge, black above. Abdomen above black in the center, striped with blue on the sides; beneath black with white hairs at the base. Anal tuft black at the base, white at the apex. Top of head black spotted with white. Collar and shoulder covers black with a white longitudinal line. Palpi above with a white dot; beneath white in the center and black on the sides. Pectus black in the center and white on the sides. Legs blackish, striped and barred with bluish white. Antennae black above, the apiculus brownish; beneath brownish, a few white scales at the base of the club, the club reddish brown.

EXPANSE. 50 to 52 mm.

TYPE MATERIAL. Holotype male and one male paratype from Colombia.

This species is closely related to *metrodorus* Bell, there being but a slight difference in the termination of the claspers of the male genitalia of the two species. Superficially *nigrescens* may be distinguished from *metrodorus* by the almost total lack of the basal rays of the primaries, which are usually well developed in *metrodorus;* in the broader submarginal band of the upper side of the secondaries and the presence of the spot of this band in interspace 7 usually lacking in *metrodorus.* On the under side of the secondaries the basal and discal rays of *nigrescens* are narrow and the submarginal band broad; in *metrodorus* the rays are as broad or broader than the submarginal band. The lack of the basal rays of the primaries in *nigrescens* causes these wings to present a very black appearance.

Brigadier W. H. Evans, to whom photographs of *nigrescens* were sent, informs me that there are specimens unidentified in the collection of the British Museum from Colombia, Ecuador, and Peru and that they agree with the characters shown in the photographs.

Pholisora (?) maculata, new species

Figure 3

MALE (UPPER SIDE).—Primaries brown at the extreme base, then crossed by a narrow whitish band suffused with pale brown, following this a brown band somewhat curved, then a whitish discal band extending from the costal to the inner margin and suffused with pale brown in the lower part and a brown dot in each of interspaces 1 and 2, the inner side of this band is irregular and the outer side of the spots in the cell and interspace 2 is deeply indented and both of these spots are hyaline, a small hyaline spot near the base of interspace 3, two still smaller spots, one each in interspaces 4 and 5, the upper in an oblique line outward with the lower one, three small, hyaline subapical spots, somewhat elongate, the upper one extending slightly outward beyond the lower ones but all in a nearly vertical line and edged with brown on the outer side, a short brown band fills the space between the pale discal band and the subapical spots, extending unbroken across the cell, below which it is divided into two spots, one each in interspaces 2 and 3, a submarginal brown band somewhat spot-like extends from the apex to the anal angle and between veins 2 and 4 is produced outward almost to the margin of the wing, then a little inward in the upper part of interspace 1 and again a little outward at the anal angle, this band and the one just previously mentioned nearly fuse between veins 2 and 6, being separated only by a narrow, indistinct paler line, a narrow, paler marginal line widest at and just below the apex and just above the anal angle in interspace 1. There is a very slight indentation in the outer margin of the wing between veins 1 and 2. Fringes pale brownish, darker at the end of the veins. There is a rather thin overscaling of fulvous brown in the basal, inner, and outer marginal areas.

Secondaries on the outer margin have a slight excavation between veins 4 and 6. Basal third brown, followed by an irregular, whitish discal band, extending from the costal margin to the inner edge of the abdominal fold, the costal spot of this band is only about one-half the width of the rest of the band, two small brown spots are enclosed in the band, one in the lower part of the cell near the apex, the other, longer vertically, below it in interspace 1, beyond the discal band to almost the margin of the wing is brown spotted with darker brown, the margin of the wing narrowly paler. Fringes alternately dark and pale brown. There is a thin overscaling of fulvous brown and some fulvous-brown hairs at the base and along the abdominal fold.

BENEATH.—Primaries about the same as above but paler, inner margin whitish. Secondaries paler than above, the whitish discal band broader and outwardly enclosing an irregular band of six brown spots, followed by an irregular band of larger brown spots and a narrow, irregular, whitish marginal line.

Thorax above brown, beneath paler brown. Abdomen above dark brown at the base, the rest pale brownish. Top of head, palpi, collar, shoulder covers, and tegulae pale brownish. Palpi beneath whitish tinged with pale brown. Pectus whitish. Antennae above brown, the club a little darker, beneath paler brown, the apical half of the shaft and the club whitish, the sides of the club red.

FEMALE.—Similar to the male but much darker brown, the pale areas much reduced on both surfaces of the wing.

EXPANSE.—Male 24 to 27 mm.; female 27 mm.

TYPE MATERIAL.—Holotype male, allotype female, one male and one female paratypes from Chapada, Campo, Brasil.

Maculata is tentatively placed in the genus *Pholisora* as it seems to be more closely allied to this group than to any of the other described genera, but it is probably not strictly congeneric. The male has neither a costal fold nor a tibial tuft. The distinctive form of the maculation as described above will readily separate *maculata* from any of the other described members of this genus as it does not closely resemble any of them.

Hesperiinae

SCHAUSANA, NEW GENUS

GENOTYPE. *Hesperia* (?) *altama* Schaus.

Apex of primaries somewhat pointed, secondaries rounded, slightly lobed at the anal angle. Antennae about half the length of the costa, the club stout, gradually thickened, apiculus moderately long or a little more than the diameter of the club. Third joint of the palpi conical and moderately short. Cell of primaries a little more than half the length of the wing. Body stout. Middle and hind tibiae with short spines; hind tibiae with one pair of long spurs. Male stigma is a sub-ovate patch of black scales in interspace 2, beginning at or just before, the rise of vein 3 and extending outward, the upper edge lying against vein 3 and the lower edge a little above vein 2.

This genus is named for Dr. William Schaus who described *altama*. In the original description *altama* was questionably placed in the genus *Hesperia*, used in a blanket sense, and Draudt, in 'Seitz Macrolepidoptera of the World,' placed in the genus *Lerema*. *Altama* does not agree with the characters of any of the genera now in use and it is therefore necessary to erect a genus for it. In general appearance the genus *Atrytone* Scudder is suggested and the probable relationship of *Schausana* is somewhere near that genus, from which it is immediately distinguished by the single pair of spurs on the hind tibiae and the unique form of the male stigma.

Thespieus ovallei, new species

Figure 2

MALE (UPPER SIDE). Primaries reddish brown. A small spot in the upper part of the cell, a little beyond the center; an oblique discal band of three spots, one very small in interspace 1 just above vein 1, one taller than broad and wider on the lower edge than on the upper, in interspace 2; a small, subquadrate one in interspace 3; two extradiscal spots, one each in interspaces 4 and 5, the lower spot much the larger, the upper spot being a mere dot; three subapical spots, one each in interspaces 6, 7, and 8, in a nearly vertical line, the lower spot in the base of interspace 6 very minute. All of these spots are hyaline and colorless except that in interspace 1 which is opaque. The stigma is grayish white and in two parts in the usual form found in this genus. The fringes are orange-yellow just above the anal angle and brown from there to the apex of the wing.

Secondaries of same color as the primaries and immaculate. Fringes orange, slightly impinged upon by the ground color at the end of the veins.

BENEATH.- Primaries above vein 2 brownish red with an irregular submarginal band of whitish overscaling from the apex to vein 2, below the apex small marginal spots of ground color between the veins cut this band into lunules, one in each interspace; the wing below vein 2 to the inner margin is paler brown. The spots of the upper side are repeated, that in interspace 1 much larger, whitish, and produced in a thin line outward along vein 1 to the anal angle, above this spot in the same interspace is a narrow, oblique, pale yellowish stripe extending to the lower outer angle of the hyaline spot in interspace 2; directly above the subapical spots is a narrow, whitish, costal stripe, another similar one behind it toward the base of the wing and another halfway between the first one mentioned and the apex of the wing. There is a fine, broken, yellowish, marginal line from below the apex to the anal angle. The stigma of the upper side is outlined by two narrow, hazy, yellowish stripes. The fringes are concolorous and less orange-yellow above the anal angle.

Secondaries brownish red, brown along the inner margin of the abdominal fold; basal third rather thinly and irregularly overscaled with whitish; an ill-defined stripe of whitish overscaling from vein 6 to the inner edge of the abdominal fold; a rather broad submarginal area of whitish overscaling from near vein 7 to vein 3. Fringes orange, darker than above. A marginal line, prominent and yellow at and just above the anal angle, from there upward thinner and whitish.

Thorax above and tegulae brownish red in the center with green reflections, green along the sides, and in certain angles all appears to be green. Abdomen above blackish with green hairs at the base; anal tuft orange. Head above, collar and shoulder covers brownish red with green reflections.

Thorax beneath with brownish and reddish-brown hairs; abdomen brown. Palpi beneath reddish brown in the center, the sides grayish. Antennae brown above, paler beneath where the club is bright yellow with a red apiculus.

EXPANSE.—45 mm.

TYPE MATERIAL.—Holotype male, Colombia.

Ovallei is closely related to *tihoneta* Weeks (*superior* Draudt) from Bolivia but may be readily distinguished from that species by the more pronounced reddish-brown ground color of the upper side of the wings, the smaller hyaline spots of the primaries, the lack of the yellowish-brown hairs covering the basal area of the upper side of both wings, the lack of hyaline spots on the secondaries.

This species is named for Señor Felipe Ovalle.

MEGATHYMIDAE

Megathymus mejicanus, new species

Figures 4, 5, 6

MALE (UPPER SIDE).- Primaries brownish black, base of wing reddish fulvous for about one-third of interspace 1, sometimes extending into the extreme base of interspace 2, and along inner margin of the wing to a point under the discal band of spots; a spot near the end of and extending across the cell, the outer edge angular, forming a more or less sharp point, the inner edge indented; a discal band composed of three spots, one in interspace 1, sagittate, extending well inward toward the base of the wing in a long sharp point, the outer edge of this spot is a little inward of the line formed by the outer edges of the two spots above it and is deeply indented, a spot in interspace 2, oblong, nearly straight on the outer edge but sometimes a little indented and angled to a point on the inner edge, an oblong spot in interspace 3 directly above the one in interspace 2 and of approximately the same length; a smaller extradiscal spot in interspace 4 and one in interspace 5 irregular in shape, a little longer than wide; four subapical spots, one each in interspaces 6, 7, 8, and 9, that of interspace 6 extends a little outward of those above it, that of interspace 9 is minute. All of these spots are yellow and covered with fulvous scales so that the exact present appearance of color depends upon how many of the fulvous scales have become lost. Fringes alternately brown and whitish.

Secondaries brownish black, basal third covered with fulvous hairs; a sharply angled discal band of five fulvous spots, the three lower ones are very large and form an almost continuous band from the upper edge of vein 6 below the outer angle to vein 1 above the anal angle, the first, and lowest spot, and the third spot are elongate and extend outward toward the margin of the wing far beyond the middle spot, the other two upper spots are very much smaller and are in interspaces 6 and 7, they extend inwardly in a line forming an angle with the line of the three lower spots. Fringes alternately brown and whitish.

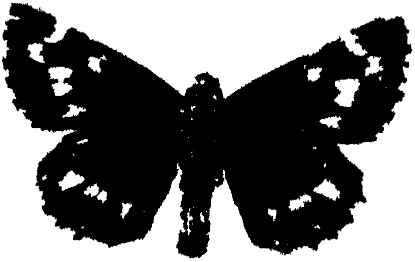


Fig. 5

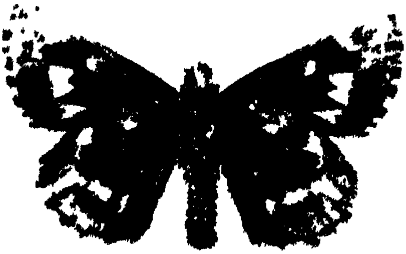


Fig. 6

Fig. 5. *Megathymus mejicanus*, new species. Upper side. Holotype.
Fig. 6. *Megathymus mejicanus*, new species. Under side. Holotype.

BENEATH. Primaries dark brown, basal, apical, and inner marginal areas paler. Spots of the upper side repeated paler in color.

Secondaries of ground color brown, the discal area overscaled with paler brown, black and grayish scales producing a mottled appearance, the inner and outer margins and along the outer margin of the abdominal fold overscaled with white; at the base of the wing below the cell are some longer brownish hairs; the spots of the discal band are repeated and all are white, the uppermost spot is much larger than on the upper surface; in addition to those spots there is a minute white spot in the end of the cell and another much larger white spot above it in interspace 7.

Thorax above covered with long fulvous hairs. Beneath gray. Tegulae with brown and gray hairs. Abdomen above and beneath brown, each segment finely bordered with gray, extending completely around the body, some fulvous hairs at the base on the upper side. Top of head, collar, and shoulder covers brown and gray. Palpi beneath whitish tinged with pale fulvous brown. Pectus gray. Legs brown with grayish hairs. Antennae brown above, beneath with some whitish scales and a white stripe on the club.

FEMALE. Similar to the male, all spots of both wings a little larger and the small white cell spot of the under side of the secondaries shows faintly on the upper side as a fulvous spot.

EXPANSE.— Male 46 to 48 mm.; female 51 mm.

TYPE MATERIAL.—Holotype male, allotype female, three male paratypes. The males from Guanacevi, Durango, Mexico (October), and the female from Rio Campo, Mexico.

In superficial appearance *mejicanus* most closely approaches *neumoegeni* Edwards and *aryxna* Dyar. From both of these species *mejicanus* differs on the upper side in the spot in the cell of the primaries being angled to a point toward the apex of the cell and indented on the side toward the base of the cell, this spot being more or less quadrate in the other two species though sometimes a little indented on the basal side in *aryxna; mejicanus* differs in the sagittate lowest spot of the discal band of the primaries and in this spot being out of line with the two spots above it, in the other two species this spot is subquadrate and in a line with the others; in *mejicanus* the fulvous basal area of the primaries in interspace 1 is continuous, in both of the other species it is somewhat divided and the outer part appears as a distinct fulvous spot. On the secondaries above the discal band of *mejicanus* is composed of five spots, three large ones in the lower part, of which the first and third are much larger than the second, and two small ones in the upper part, while in both of the other species this band is composed of four spots in the lower part and one in the upper part, the four lower spots, while tapering a little, are approximately in a straight line on their outer edge. On the under side of the secondaries the spots of the discal band of *mejicanus* are white, in the other two species these spots are variably overscaled with grayish white, sometimes very heavily so, except the spots in interspace 7, and the entire undersurface of these wings is overscaled with this color, usually heavily and evenly in *neumoegeni* and less so in *aryxna;* in *mejicanus* the palpi beneath are whitish tinged with pale fulvous brown, in the other two species they are white with only a few pale brownish hairs intermixed. The female allotype *mejicanus* differs from *neumoegeni* and *aryxna* females in the same way that the males differ and in addition the spot in interspace 3 of the discal band of the primaries is well separated from the cell spot, in both of the other species these two spots are usually joined and when separated the intervening space is usually narrow.

The form of the male genitalia of *mejicanus* is very different from that of both *neumoegeni* and *aryxna*, especially so in the claspers, which in these two species are apically divided into an upper and lower flange, the lower having a large preapical, dorsal projection carrying a number of short but well-developed teeth, whereas in *mejicanus* the claspers are not apically divided but terminate in a rounded apex somewhat flattened on top, behind which there is a small excavation and the dorsal edge produced in a short flange over it.

Figure 4 is from the genitalia of a male paratype; figures 5 and 6 are the upper and under side of the male holotype, from photographs made by Mr. Cyril F. dos Passos.

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NOTES ON CARANGIN FISHES

IV.—ON *CARANX CRYSOS* (MITCHILL)[1]

By J. T. Nichols

Though *Caranx crysos* is a common species, there is considerable doubt regarding the habit of its early stages, and only one specimen of it less than 100 mm. in standard length has come into my hands. This specimen has a recognizably different color pattern from related forms at a comparable size, and is here described so that the species may be recognized where it might otherwise be overlooked. It was taken among gulf weed in the easterly edge of the Gulf Stream off Bimini, Bahamas, July 19 to 22, by the Michael Lerner Expedition of 1937, and is figured with a somewhat larger *Caranx ruber* with the same data, for comparison. Young *Caranx ruber* from 17.5 to 43 mm. standard length were common in the weed at this date (Copeia, 1937 (4), p. 236).

The specimen of *Caranx crysos* is 22 mm. in standard length. Its color in alcohol is pale thickly punctulate with dark spots of varying size, the largest of which are round and conspicuous under a hand lens. The spinous dorsal is dusky and other fins pale. Depth in standard length is 2.4; head, 2.7 1/2. Eye in head, 3.2; pectoral (bluntly pointed), 1.8 1/2. Curve of lateral line (chord) in straight part, 1.7. Twenty-two dorsal and 20 anal soft rays can be counted; about 33 poorly developed scutes, and about 24 gill-rakers on the lower limb of the first arch.

It is interesting to compare the variation and growth changes in a series of 13 *Caranx crysos* of 129 to 235 mm. standard length with those in a series of 19 *C. hippos* of 117 to 245 mm., both obtained at Beaufort, North Carolina, by Sidney Shapiro in July and August, 1938. For one thing in the *C. hippos* series the proportion between curved part of the lateral line and its straight part varies little with no significant change with size of fish. Six specimens of 117 to 130 mm. have the curve (that is, its chord measured with a pair of dividers) in straight part, 1.0 to 1.1 (average 1.02); seven of 160 to 167 mm., 0.9 to 1.1 (1.02); six of 235 to 245 mm., 0.9 1/2 to 1.1 (1.05). On the other hand, in six *C. crysos* from 129 to 165 mm. this measurement varies from 1.5 to 1.8 (average

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[1] Results of the Michael Lerner Ichthyological Expeditions, No. 16.

1.60); in seven from 170 to 235 mm., from 1.6 to 1.9 (1.77). Of this increase in proportional length of the straight part of the lateral line, more hereafter.

To make the series of *Caranx crysos* more representative of the species I have added to it available material in The American Museum of Natural History as follows: one specimen 110 mm. long from Haiti, one 124 mm. long from Trinidad, seven 129 to 152 mm. long from Venezuela, and five 103 to 132 mm. long from Rio de Janeiro (W. J. Morden Expeditions), also one of 311 mm. from Natal, Brazil (E. C. Starks). This gives 28 specimens ranging from 103 to 311 mm. standard length. Their dorsal soft rays, usually 23, vary from 21 to 24 (average 22.8); anal, usually 19, often 20, vary from 18 to 21 (average 19.4). Irrespective of size of fish or relative length of straight part of lateral line, the scutes are variable, sometimes stopping an appreciable distance short of its front end, sometimes a scute or two on the commencement of the arch; scutes vary from 40 to 50 (average 45.6). Gill-rakers on the lower limb of the first arch vary from 25 to 33 (average 27.9).

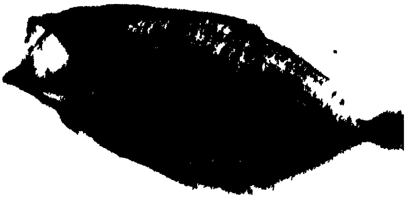

Fig. 1. *Caranx crysos*, 22 mm. standard length, A.M.N.H. No. 13750, photograph by Myron Gordon.

Comparing them by size groups, at 103 to 132 mm. standard length (11 specimens), depth in this length is 2.6 to 3.0 (average 2.93); head, 3.3 to 3.6 (3.46); eye in head, 3.5 to 4.0 (3.69); greatest width, 1.9 to 2.3 (2.08); pectoral, 0.9 1/2 to 1.2 (1.03); curve of lateral line in straight part, 1.5 to 1.7 (1.59).

At 140 to 165 mm. (9 specimens), depth is 2.8 to 3.0 (average 2.90); head, 3.4 to 3.7 (3.58); eye in head, 3.6 to 4.2 (3.84); width, 1.8 to 2.0

(1.94); pectoral, 0.9 to 1.0 (0.97); curve of lateral line in straight part, 1.5 to 1.8 (1.64).

At 170 to 311 mm. (8 specimens), depth is 2.8 to 3.3 (average 2.97 1/2); head, 3.5 to 3.8, (3.62 1/2); eye in head, 3.8 to 5.0 (4.10); width, 1.7 to 1.9 (1.84); pectoral, 0.7 1/2 to 0.9 (0.83); curve of lateral line in straight part, 1.6 to 1.9 (1.76).

The variability and increase in comparative length of the straight part of lateral line with size of fish definitely shown by *Caranx crysos* seem to be unusual. For instance, in the *Caranx melampygus* studied from the Hawaiian Islands there is a notable decrease in its comparative length (Copeia, 1935 (4), p. 192). Presumably it is a matter of different relative growth, the posterior part of the body growing more in *crysos*, the anterior part more in *melampygus*. This introduces a theoretical consideration of the arch in the lateral line and short body cavity characteristic of carangin fishes. In the less specialized bluefish *Pomatomus saltatrix* with caranx-like form and swimming habits but longer body cavity there is no such arch, the lateral line descends in a gentle curve and becomes straight only in the center of the peduncle as is usual in fishes. Is it not reasonable to suppose that the development of the arch in carangin phylogeny has been as much by expansion of the peduncular region carrying the inherited central position of its lateral line forward and incidentally making a more or less abrupt arch of the anterior portion, as by realignment of the line to correlate with realign-

Fig. 2. *Caranx ruber*, 30 mm. standard length, A.M.N.H. No. 13751, photograph by Myron Gordon.

ment of deeper seated structures. There must have been realignment of structures incidental to the change to short body-cavitied carangins from more normal longer body-cavitied fishes, but it seems not unlikely that expansion of peduncular elements in phylogeny played a considerable part in these changes. On the other hand, perhaps it is merely the symmetrical character of the peduncular musculature which ha been carried forward, and this determines the central position of the lateral line, and has also limited the body cavity posteriorly. In any event the slight lengthening of the straight part of the lateral line in *Caranx crysos* ontogeny is easy to correlate with environmental adaptation of that particular fish. The slender swift-swimming phase characteristic of these fishes in general is particularly well marked in this species and persists to sizes where various related forms show signs of relative slowing down.